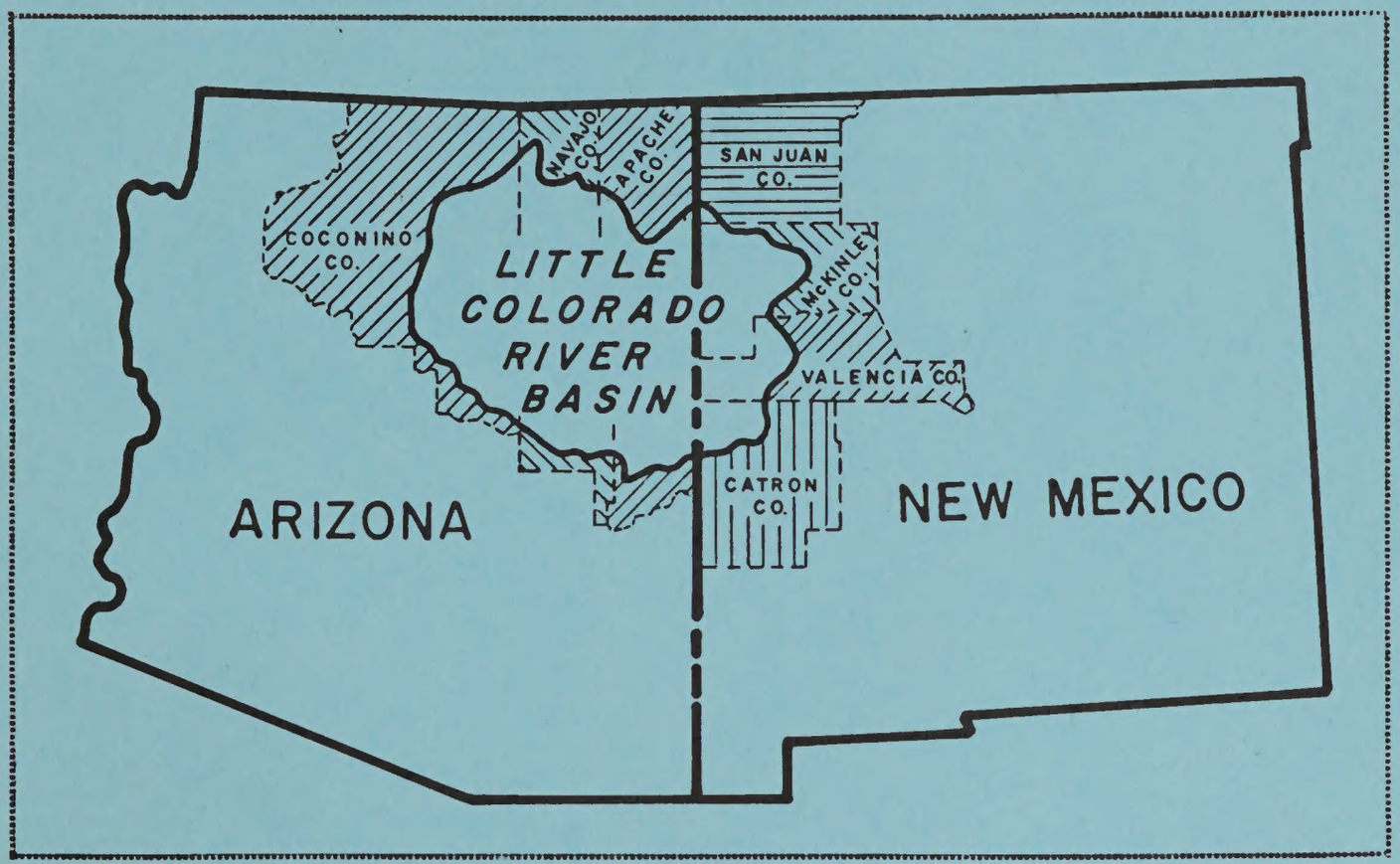
LITTLE COLORADO RIVER BASIN
ARIZONA-NEW MEXICO

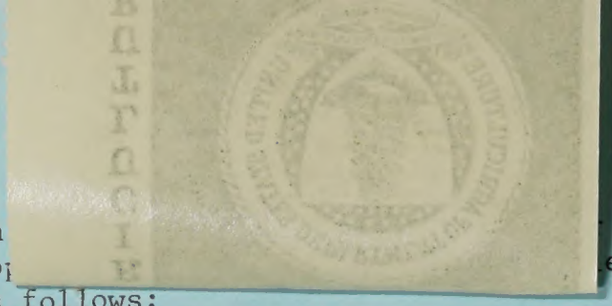
APPENDIX I
DESCRIPTION OF BASIN



U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ECONOMIC RESEARCH SERVICE
FOREST SERVICE

In cooperation with the states of
ARIZONA AND NEW MEXICO

December 1981



The "Description ... (4) such appendices which supports and supp... es and subsections of each appendice are as follows:

APPENDIX I: DESCRIPTION OF BASIN

Section 1: Physical Description

Section 2: Socio-Economic Base

APPENDIX II: WATER RESOURCES

Section 1: Irrigation

Section 2: Municipal and Industrial Water Supply

Section 3: Rural Domestic and Livestock Water Supply

Section 4: Development of Surface Water Resources

Section 5: Surface Water Budgets (Including Pumped Groundwater)

APPENDIX III: EROSION AND SEDIMENT, AND FLOODING

Section 1: Erosion and Sediment

Section 2: Flooding

APPENDIX IV: RECREATION, FISH AND WILDLIFE, AND TIMBER

Section 1: Recreation

Section 2: Fish and Wildlife

Section 3: Timber

LITTLE COLORADO RIVER BASIN

COOPERATIVE STUDY

ARIZONA - NEW MEXICO

APPENDIX I

DESCRIPTION OF BASIN

This appendix was prepared pursuant to Section 6 of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, 68 Stat. 666, as amended and supplemented). This appendix presents information on the basic resources within the Little Colorado River Basin. It provides input data for other study items and provides the users of the report with background information needed to understand conditions that exist in the Basin. This includes socio-economic data such as historical data on population, employment, agricultural and other production, income and earnings.

LITTLE COLORADO RIVER BASIN
COOPERATIVE STUDY

ERRATA SHEET

1. Effective July 1, 1981, Valencia County, New Mexico, was divided into two counties. That portion within the Little Colorado River Basin became Cibola County.

2. In June 1981, the Economics and Statistics Service was reorganized to form the Economic Research Service and the Statistical Reporting Service.

3. The Arizona Water Commission is now the Arizona Department of Water Resources.

LITTLE COLORADO RIVER BASIN

COOPERATIVE STUDY

APPENDIX I

DESCRIPTION OF BASIN

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SECTION 2 - SOCIO-ECONOMIC BASE

SECTION I

PHYSICAL DESCRIPTION

SECTION I

PHYSICAL DESCRIPTION

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SECTION I

PHYSICAL DESCRIPTION

LOCATION

The Little Colorado River Basin covers an area of over 17.2 million acres or 26,964 square miles; 21,667 square miles in northeastern Arizona and about 5,297 square miles in northwestern New Mexico. It extends into portions of seven counties in two states. These include Coconino, Navajo and Apache Counties, in Arizona; and Catron, Valencia, McKinley and San Juan Counties, in New Mexico. (See Location Map, following page 1-2.)

The Basin is bounded on the north by the San Juan Basin, on the east by the Rio Grande Basin, on the south by the Gila and Salt River Basins and on the west by the Lower Mainstem of the Colorado River.

There are five Indian reservations that lie partially or wholly within the Little Colorado River Basin. These include the Navajo, Hopi, Navajo-Ramah, Zuni and the Fort Apache Reservations. The Hopi and Navajo Reservations comprise approximately the northern half of the Arizona portion of the Basin, with the Navajo Reservation extending into San Juan and McKinley Counties, New Mexico. The Ramah-Navajo and the Zuni Reservations are also located in New Mexico in parts of McKinley and Valencia Counties. A small part of the Fort Apache Reservation lies along the southern edge of the Basin in Apache and Navajo Counties, Arizona.

There are three natural resource conservation districts (NRCD) located in the Arizona portion of the Basin. These are the Apache, Coconino and Navajo County NRCD's. Soil Conservation Service Field Offices for these districts are located in Springerville, Flagstaff and Holbrook, respectively. Six Soil and Water Conservation Districts are presently being formed on the Navajo and Hopi Indian Reservations. The boundaries of these districts will follow existing agency boundaries and will be served by the Soil Conservation Service in Arizona, including the districts on Indian lands in New Mexico.

In New Mexico, there are portions of four Soil and Water Conservation Districts (SWCD) on non-Indian lands. These include Quemado, McKinley, Lava and Salado SWCD's.

The Little Colorado River Plateau Resource Conservation and Development (RC&D) Area in northeastern Arizona encompasses all of the Arizona part of the Basin, except for the non-reservation part in Coconino County. The Little Colorado River Plateau RC&D Area also includes that portion of the Navajo Reservation in New Mexico. The rest of the Arizona portion of the Basin is within the Cocopai Resource Conservation and Development Area. The McKinley, HUB, and Southwest New Mexico RC&D Areas extend into the Basin. The Basin is also within the Four Corners Regional Commission Economic and Development Area.

CLIMATE

The climate of the Little Colorado River Basin is characterized by mild summers and cold winters. The major part of the Basin is classified as a cool, dry, steppe climate. The climatic conditions, however, range from desert, to steppe, to highland based on a combination of precipitation and temperature. (54*) The desert area consists of a narrow strip along the Little Colorado River Valley from Winslow to the river's mouth. The highland area forms a band along the Mogollon Rim on the southern edge of the Basin, and a smaller area located near Fort Defiance in the northeast corner of the Basin. The desert and steppe climates are characterized by a lack of precipitation, whereas, the highland areas have a relatively higher amount of precipitation.

PRECIPITATION

Mean annual precipitation is between 8 and 12 inches in the valleys and plateaus, and 16 to 24 inches in the forested parts of the mountains. In the higher mountain regions, representing a very small percentage of the Basin, the average precipitation is more than 30 inches (See Normal Annual Precipitation Map, following page 1-2). A primary wet season extends from July through October with July and August being the wettest months. The remainder of the year is very near or below the yearly average (Figure 1-1, page 1-3). Generally during the winter months, the precipitation is in the form of snow. Depths exceeding 14 feet have been recorded in the Basin on Baldy Peak near Greer. The driest months are May and June.

TEMPERATURE

There are moderate variations of temperatures across the Basin. Daily average temperatures in January and July are shown on Daily Average Temperature Maps for these months following page 1-4. Minimum temperatures in January are near or below freezing over the total Basin. The mean minimum January temperatures range from about 19.3 degrees Fahrenheit at Cameron, Arizona to a low of 6.5 degrees at McGaffey, New Mexico. Extreme January temperatures of -50 and -55 degrees have probably occurred near the top of Humphrey's Peak located north of Flagstaff. An unofficial -57 degrees was noted at Ciniza, New Mexico, located east of Gallup, on January 13, 1963 (46).

The mean high July temperature range from the mid-ninety's in the valley and plateaus, to the low-eighty's in the mountains. The maximum recorded July temperature is 110 degrees as recorded at Cameron and Leupp. The extreme high for the City of Holbrook is 109 degrees.

Not only is there a large flucatuation between summer and winter temperatures; but because of low moisture characteristics, intense surface heating occurs during the day, and radiational cooling is evident at night. This process produces a large diurmal temperature range, averaging 30 degrees and sometimes exceeding 40 degrees.

* Numbers in parenthesis refer to reference numbers listed in back of the respective sections of this Appendix.

LOCATION MAP

15020004 Hydrologic Unit Code, U.S. Water Resources Council

Note: Some maps show the Continental Divide as being here. The area between the two boundaries is a closed basin.

Note:
The boundary as shown for the Hopi Indian Reservation does not reflect division of the joint use area resulting from the Navajo-Hopi Settlement Act of Dec. 22, 1974, P. L. 93-531. Final boundaries have not been determined as of this printing.

Source:
Base map prepared by SCS, WTSC Carto Unit from USGS 1:500,000 series.
Thematic detail compiled by state staffs from previously published SCS data.
U. S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

USDA-SCS-PORTLAND, OR 1980

LOCATION MAP

LITTLE COLORADO RIVER BASIN

ARIZONA AND NEW MEXICO

JUNE 1980

10 0 10 20 MILES

SCALE 1:1,000,000

BY

ARIZONA WATER COMMISSION

NEW MEXICO STATE ENGINEER

AND

U.S. DEPARTMENT OF AGRICULTURE

M7-EN-23833

NORMAL ANNUAL PRECIPITATION 1941-1970

LITTLE COLORADO RIVER BASIN

ARIZONA AND NEW MEXICO

APRIL 1981

10 0 10 20 30 40 MILES

SCALE 1:2,000,000

Source:
Laboratory of Climatology Arizona State University.
Climatography of the U.S. (New Mexico).
Base map prepared by SCS, WTSC Corto Unit from USGS 1:500,000 series.
Thematic detail compiled by state staff.

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

USDA SCS PORTLAND OR 1981

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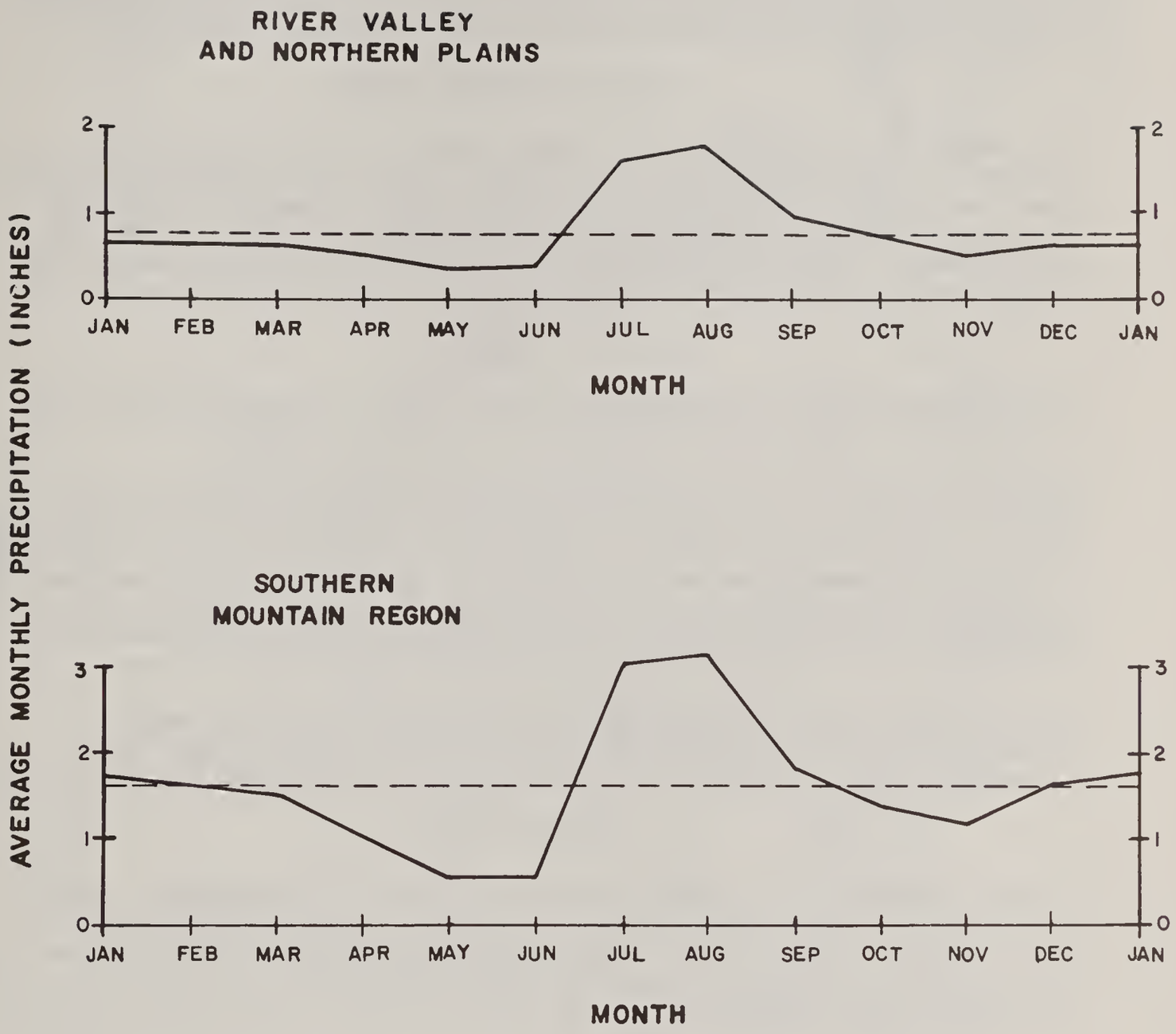

FIGURE 1-1 Average Variation of Mean Monthly Precipitation in the Little Colorado River Basin, Arizona and New Mexico. Horizontal dashed line superimposed on curve indicates the average of the twelve monthly values. (Arizona Climate, C. R. Green and W. D. Sellers, 1964, page 10).

EVAPORATION

The combination of high temperatures and low humidity causes high rates of evaporation and transpiration within the study area. In the valley and plateaus, where the human need for water is greatest, there is the least amount of precipitation; and the potential for evapotranspiration is greatest. Mean annual lake evaporation rates vary from about 40 inches in an area near Springerville to 55 inches in the Cameron-Tuba City-Holbrook area. (See Mean Annual Lake Evaporation Map, following page 1-4.)

LENGTH OF GROWING SEASON

The length of the growing season ranges widely in the study area and depends on the local elevation and on the nature of the surrounding terrain. Based on a 32-degree threshold, the growing season ranges from about 90 days in the mountains south of Flagstaff and Springerville, to 180 days near Cameron. Most of the Basin has a growing season ranging between 120 to 150 days. (See Mean Frost Free Period Map, following page 1-4.)

WIND

Published wind data in the Basin is scarce. The only available wind data are two first class stations located at Winslow and Flagstaff.

Winslow lies in one of the windiest parts of the state. The relatively flat to rolling, barren terrain does little to reduce the force of the wind. "Also since the region is relatively far north, it is often affected by the cool season winds associated with the passage of middle-latitude storm systems. Sandstorms are quite common..." (3) Wind speeds are generally less than 15 miles per hour, however, maximum velocities near 60 miles per hour have been recorded during intense thunder storms.

Wind speeds at Flagstaff are slightly lower than those experienced at Winslow, and average speeds generally exceed ten miles per hour in the afternoon. The lightest winds are experienced in the summer and fall. (3)

RELATIVE HUMIDITY

Relative humidity, the moisture content in the air, is expressed as the percent of the amount which the air could hold. Wide daily variations occur within the study area. Relative humidity reaches a peak in August, has similar peaks during December through February, and declines to the low point in May and June.

Source:
Laboratory of Climatology Arizona State University.
Climatography of the U.S. No. 81 (New Mexico).
Base map prepared by SCS, WTSC Carto Unit from USGS 1:500,000 series.
Thematic detail compiled by state staff.

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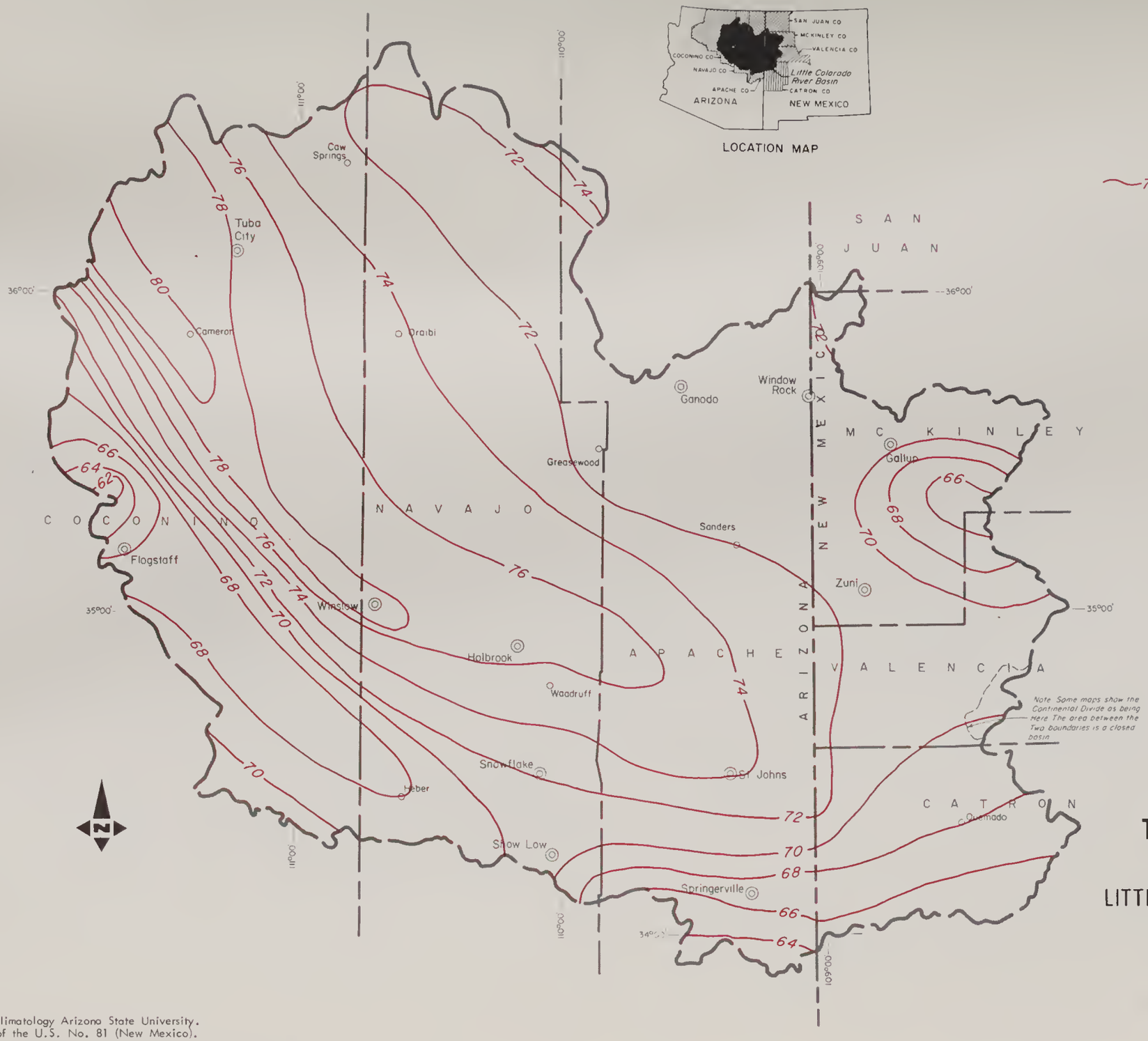

DAILY AVERAGE TEMPERATURE, JULY 1941-1970

LITTLE COLORADO RIVER BASIN

ARIZONA AND NEW MEXICO

MAY 1979

10 0 10 20 30 40 MILES

SCALE 1:2,000,000

Source:
Laboratory of Climatology Arizona State University.
Climatography of the U.S. No. 81 (New Mexico).
Base map prepared by SCS, WTSC Carta Unit from USGS 1:500,000 series.
Thematic detail compiled by state staff.

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USDA SCS PORTLAND OR 1981

M7-0L-24030-1

Source:
After Farnsworth, Peck, and Thomson by private communication.
Base map prepared by SCS, WTSC Carto Unit from USGS 1:500,000 series.
Thematic detail compiled by state staff.
U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

USDA SCS-PORTLAND OR 1981

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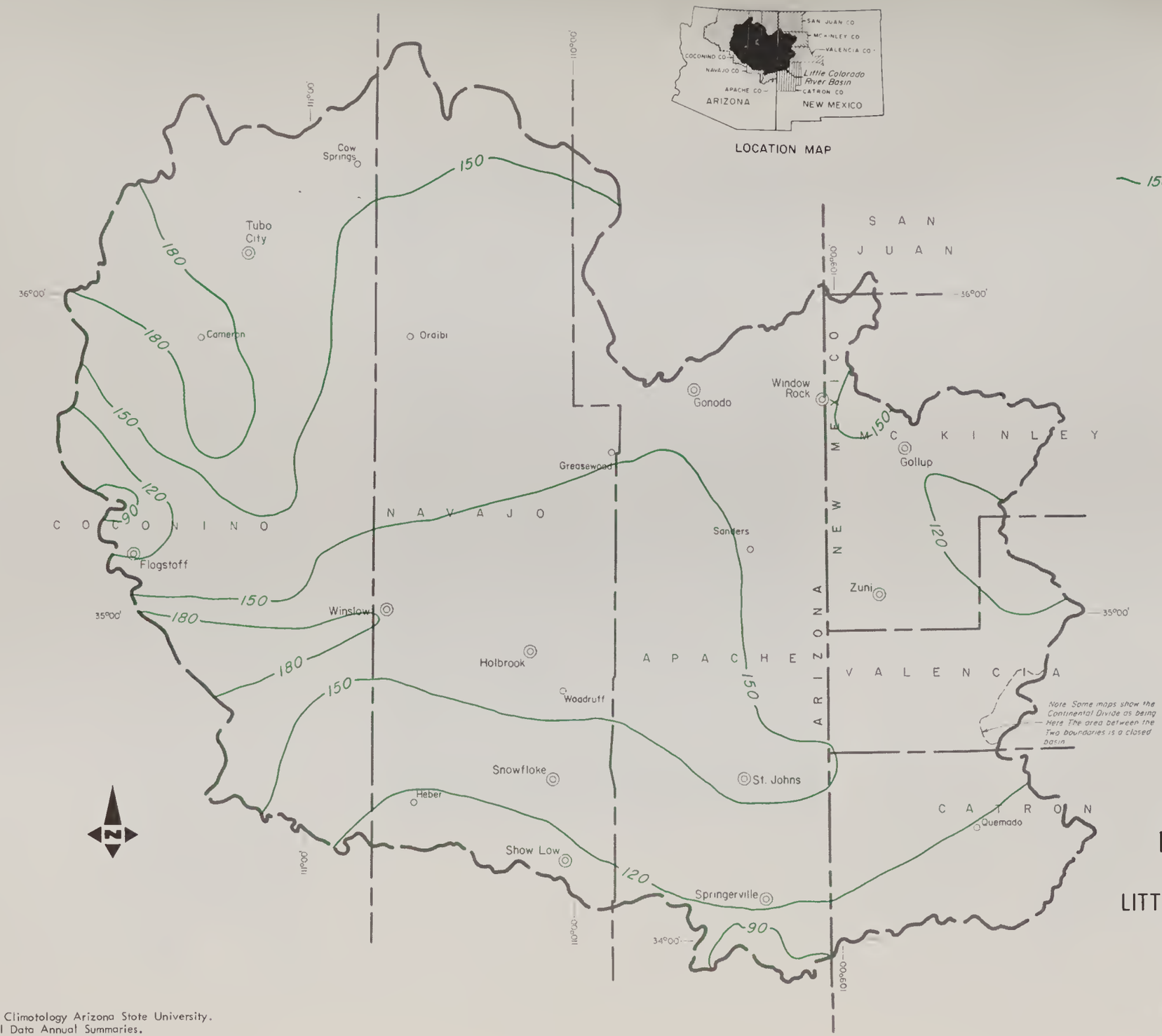


MEAN LENGTH OF FROST-FREE PERIOD 1941-1970

LITTLE COLORADO RIVER BASIN

ARIZONA AND NEW MEXICO

MAY 1979

10 0 10 20 30 40 MILES

SCALE 1:2,000,000

Source:
Loboratory of Climotology Arizona Stote University.
Climatological Data Annual Summaries.
"Climate of New Mexico," (1969).
Base map prepared by SCS, WTSC Carta Unit from USGS 1:500,000 series.
Thematic detail compiled by state staff.

U S DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE USDA SCS PORTLAND, OR 1981

M7-0L-24030-3

Only in July, and then only in certain parts of the Basin, does the average temperature-humidity index[1/] exceed an index of 79, at which point most people begin to feel uncomfortable. Over most of the Basin, the temperature-humidity index remains in or near the comfortable range during most of the summer.

LAND RESOURCES

TOPOGRAPHY

The topography of the 26,964 square mile Little Colorado River Basin is varied and diverse. The White Mountains and the Mogollon Rim in Arizona along with the Gallo Mountains in New Mexico form the southern boundary of the Basin; the Coconino Plateau forms the western; the Kaibito Plateau, Black Mesa, and the Chuska Mountains form the northern; and the West Continental Divide forms the eastern boundary.

The Basin is a scenic area with volcanic peaks, forested mountains and plateaus, and rolling plains, with multihued crags and cliffs cut by huge canyons. It offers a study of nature in sharp contrast, ranging from the Alpine Tundra of Humphrey's Peak near Flagstaff, Arizona (Photo 1-1) to "badlands" (Photo 1-2) and colorful "painted deserts" on the Navajo Indian Reservation (Photo 1-3).

Photo 1-1: A view of snow capped Humphrey's Peak, looking northwest.

1/ In hot weather, personal comfort increases with decreasing air temperature and relative humidity. To judge the combined effect of these two climatic elements, the U.S. Weather Bureau devised the temperature-humidity index which is defined by the following simple formula: Temperature-humidity index = 0.4 (air temperature + wet bulb temperature) + 15. Both temperatures are in degrees Fahrenheit. "Arizona Climate 1931-72", Revised, Second Edition, edited by William D. Sellers and Richard H. Hill, The University of Arizona Press, 1974.

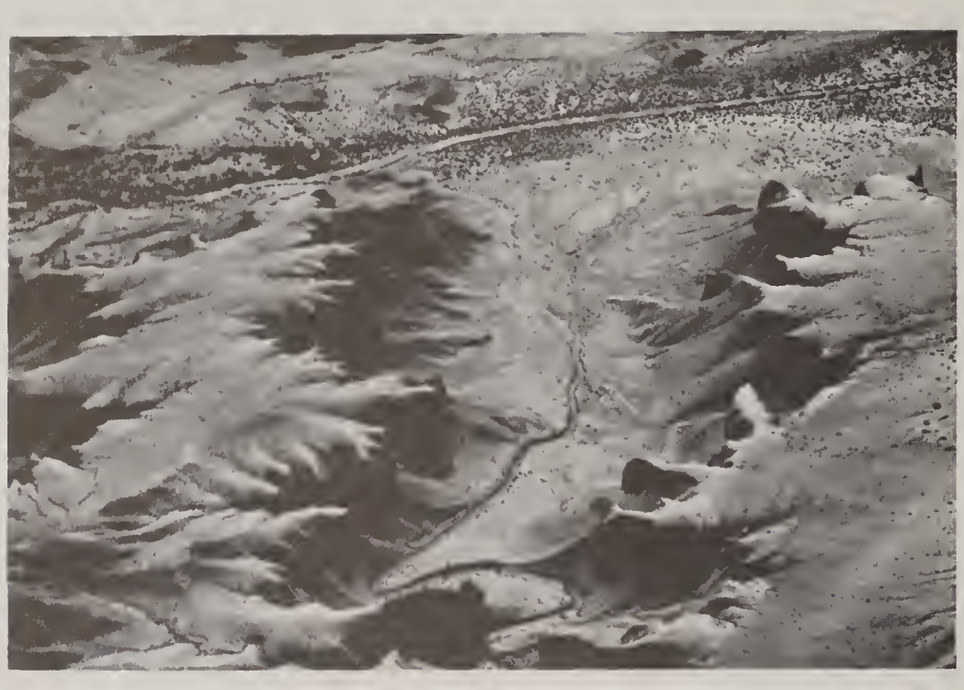


Photo 1-2: An aerial view of badland areas located near Grand Falls, Arizona.

Photo 1-3: An aerial view of the Painted Desert area located northeast of Holbrook.

The two highest mountains in Arizona are in the Basin; Humphrey's Peak (12,633 ft.) in the volcanic San Francisco peaks north of Flagstaff and Mt. Baldy (11,403 ft.) in the forested White Mountains to the southwest of Springerville.

Surface elevations in Arizona range from 12,633 feet at Humphrey's Peak down to about 2,700 feet where the Little Colorado joins the Colorado River at the Grand Canyon near Cape Solitude. These two points are only about 58 air miles apart.

Surface elevations in New Mexico range from 10,244 feet at Alegros Mountain, southeast of Quemado, to about 6,000 feet where Carrizo Wash crosses the Arizona-New Mexico state line, four miles south of the Valencia-Catron County line. These two points in New Mexico are about 56 air miles apart.

There is a strong correlation in the Basin between elevation, climate and vegetal cover. A general view of the range in elevation is provided by the Vegetation Communities Map, following page 1-42.

Ponderosa pine is the dominant species, growing between 5,500 and 8,000 feet in elevation, in a basically pure type (Photo 1-4). Mixed conifer occurs from approximately 8,000 to 12,000 feet in elevation. The spruce-fir forests are at the higher elevations. A transition zone of juniper-pinon and grasslands range in elevation from about 4,500 to 7,000 feet (Photo 1-5). The area north of the Little Colorado River is "Indian Land" characterized as a broad plateau dissected by canyons and escarpments (Photo 1-6).

Photo 1-4: Typical view of ponderosa pines which rim the southern part of the Basin. View is looking west along the Mogollon Rim.

Photo 1-5: Grassland interspersed with juniper-pinon stands north of St. Johns, Arizona.

Photo 1-6: Typical view of the desert landscape within the Basin showing a broad plateau dissected by a deep channel with buttes and mesa in the background.

The Basin is about 245 air miles in length with an average width of 135 air miles. The northernmost point of the Basin is Tall Mountain of the Shonto Plateau on the Navajo Indian Reservation; the southernmost point is near Noble Mountain south of Nutrioso, Arizona; the westernmost point is Double Top Mountain NW of Flagstaff, Arizona; and the easternmost point is in the Sawtooth Mountains a few miles east of Pie Town, New Mexico.

The Basin has a northwest drainage trend. The longest drainage course, about 300 miles, is along the Little Colorado-Carrizo Wash-Largo Creek from the Colorado River to near Pie Town, New Mexico. However, the main drainageway is along the Puerco and Little Colorado Rivers, which drop about 13.0 feet per mile from Gallup, New Mexico to the Colorado River.

PHYSIOGRAPHY

Physiographically, the Little Colorado River Basin is located in the Colorado Plateau Province. Distinguishing physiographic features of the Colorado Plateau are (44):

a. Altitudes are higher than 5,000 feet over most of the plateau; and several peaks are over 11,000 ft.

b. Despite the existence locally of a high degree of structural relief, gently dipping sedimentary rocks characterize much of the province.

c. Deep canyons are more common here than in any other part of the United States.

d. Except at high altitudes the climate is semi-arid to arid. Extensive bare rock, sparse vegetation, and spasmodic rainfall make for maximum runoff and sheet erosion.

e. Erosion has produced innumerable escarpments and structural benches. Retreating escarpments might be considered the most characteristic feature of much of the province.

f. Mountains caused by intrusion of igneous rock and volcanic origin exist within the province, but mountain ranges are lacking.

The Colorado Plateau is subdivided into six sections. The primary basis for subdivision is altitude and extent of dissection. Three of these sections lie within the Little Colorado River Basin: the Grand Canyon Section, the Navajo Section, and the Datil Section. (See Physiographic Section Map following page 1- 10.)

Grand Canyon Section

Structurally this is the highest part of the Colorado Plateau. The oldest rocks in this section are completely deformed Precambrian formations. These are overlain by about 5,000 feet of Paleozoic formations that thicken northward to nearly 8,000 feet. Precambrian and Paleozoic formations are exposed in the Grand Canyon.

About a third of the Grand Canyon Section is covered by lavas. The area is dotted by several hundred volcanic cones. The highest of these is San Francisco Mountain including Humphreys Peak which lies about 5,000 feet above the plateau (12). The lavas unconformably overlie Paleozoic and later formations, which had been faulted, folded, tilted northeastward, and exposed long before the earliest lava (Tertiary) eruptions. Several thousand feet of Mesozoic formation were removed by erosion and the Colorado River had already cut deeply into the Grand Canyon by the time the first lavas were erupted. (18)

Meteor Crater is a unique topographic feature near the southeast edge of the Grand Canyon section. The origin of this feature has been much debated, but evidence for a meteorite impact now seems to be very strong. The average width of Meteor Crater is about 570 feet, and its floor lies some 600 feet below the highest point on its encircling rim. The rim is composed of Triassic and Permian age strata.

The floor of the crater is underlain by Pleistocene and Recent deposits. This suggests that the meteorite impact took place very late in geologic time. (44)

Navajo Section

A vast region in northeastern Arizona and northwestern New Mexico is designated the Navajo Section from the name of the Indian reservation which occupies about half of this section. It is a structural depression that is mainly composed of sandstone with lesser amounts of shale. The strata are not quite horizontal and have been subject to great erosion in an arid climate. The mesas, cuestas, rock terraces, retreating escarpments, canyons, and dry washes are distinctive features of the landscape. In some parts volcanic necks and buttes are abundant. (12)

Structurally, this large area consists of two synclinal basins separated by the east-dipping Defiance monocline which trends north-south. On this truncated monocline rests a remnant of horizontal Eocene sediment (Chuska Mountains). (12)

The San Juan Basin, on the east side of the Defiance uplift, alone comprises nearly half of the Navajo section. It contains deep Tertiary fill resting on rocks of late Cretaceous age. Cretaceous rocks crop out around the margins of the basin. (44)

The western basin is much less depressed and barely preserves, in its highest central part, the beds that appear at the rim of the eastern basin and which are deeply buried near its center. This is the Black Mesa, a dissected plate of sandstone with outfacing cliffs on all sides. On the north and east, these are almost continuous, and are 1,200 to 2,000 feet high. It is capped with Cretaceous sandstone. (12)

Datil Section

The south rim of the Colorado Plateau in New Mexico and Eastern Arizona is known as the Datil Section, an extensive area covered by thick lavas. The earliest lavas are middle Tertiary age, but volcanism continued intermittently into recent times. (18)

PHYSIOGRAPHIC SECTIONS

LITTLE COLORADO RIVER BASIN

ARIZONA AND NEW MEXICO

APRIL 1981

10 0 10 20 30 40 MILES

SCALE 1:2,000,000

Source:
Base map prepared by SCS, WTSC Carto Unit from USGS 1:500,000 series.
Thematic detail compiled by state staff. (U.S. GEOL. SURVEY, FENNEMAN, 1931)
U S DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE USDA SCS PORTLAND OR 1981

M7-0L-24030-19

One of the most prominent parts of the Datil section is the Zuni Uplift, which has a structural relief of at least 5,000 feet. The Zuni Uplift differs from most of the upwarps of the Colorado Plateau in that Precambrian igneous and metamorphic rock are exposed at its center. Above the Precambrian rocks lies some 6,000 feet of sediment ranging in age from Permian to Pleistocene. Elevation of the Zuni Uplift exceeds 9,000 feet. (44)

GEOLOGY

Rocks exposed in the Basin range in age from Precambrian to Recent. Distribution of the major exposed rock units are shown on the Geology Map, following this page.

Exposures of Precambrian rock in the Arizona portion of the Basin are very limited, although the entire area is underlain by such rocks at depth. Mapped exposures are on the Defiance Plateau north of Ft. Defiance and south of Window Rock near Hunter's Point. Exposed rocks consists of granite, quartzite, silicifed limestone, greenstone, and low grade phyllite.

In New Mexico, Precambrian gneissic granite is exposed in the Zuni Mountains southeast of Gallup. The Precambrian rocks are dominately reddish-pink gneissic granite and lessor amounts of metarhyolite. The granite forms the core of the Zuni Uplift.

Rocks of Cambrian age also have very limited exposure in the Basin, being mapped only in the gorge of the Little Colorado River. Rocks of the Tonto Group crop out in the lower sections of the gorge. Members of this group include the Tapeats Sandstone, Bright Angel Shale, and Muav Limestone. The Tapeats Sandstone is a moderate orange-pink to light gray, generally cross-bedded sandstone with some mudstone and siltstone beds included. The Bright Angel Shale is lithologically variable, consisting of soft, green micaceous, sandy shale with alternating layers of shale and purplish-brown sandstone. The Muav Limestone includes shale and sandstone with thin-bedded, bluish-gray limestone with shale.

Rocks of Devonian age unconformably overlie the Tonto Group. The Devonian is represented by the Temple Butte Limestone. The Temple Butte is a lavender to purple limestone with gray, fine-grained, silty dolomites. Known exposures of this formation in the Basin are limited to the lower reaches of the gorge of the Little Colorado River.

The Redwall Limestone of Mississippian age overlies the Temple Butte Limestone, and is exposed in the gorge of the Little Colorado River. It is in part dolomitic.

The Supai Formation of Pennsylvanian-Permian age is exposed in the Little Colorado River gorge and on the Defiance Plateau. The Supai is composed of alternating beds of reddish-brown sandstone, siltstone, mudstone, gray limestone and white gypsum.

Rocks of Permian age crop out abundantly in the Basin. As a result of alternating advance and retreat of the sea, a sequence of sandstone,

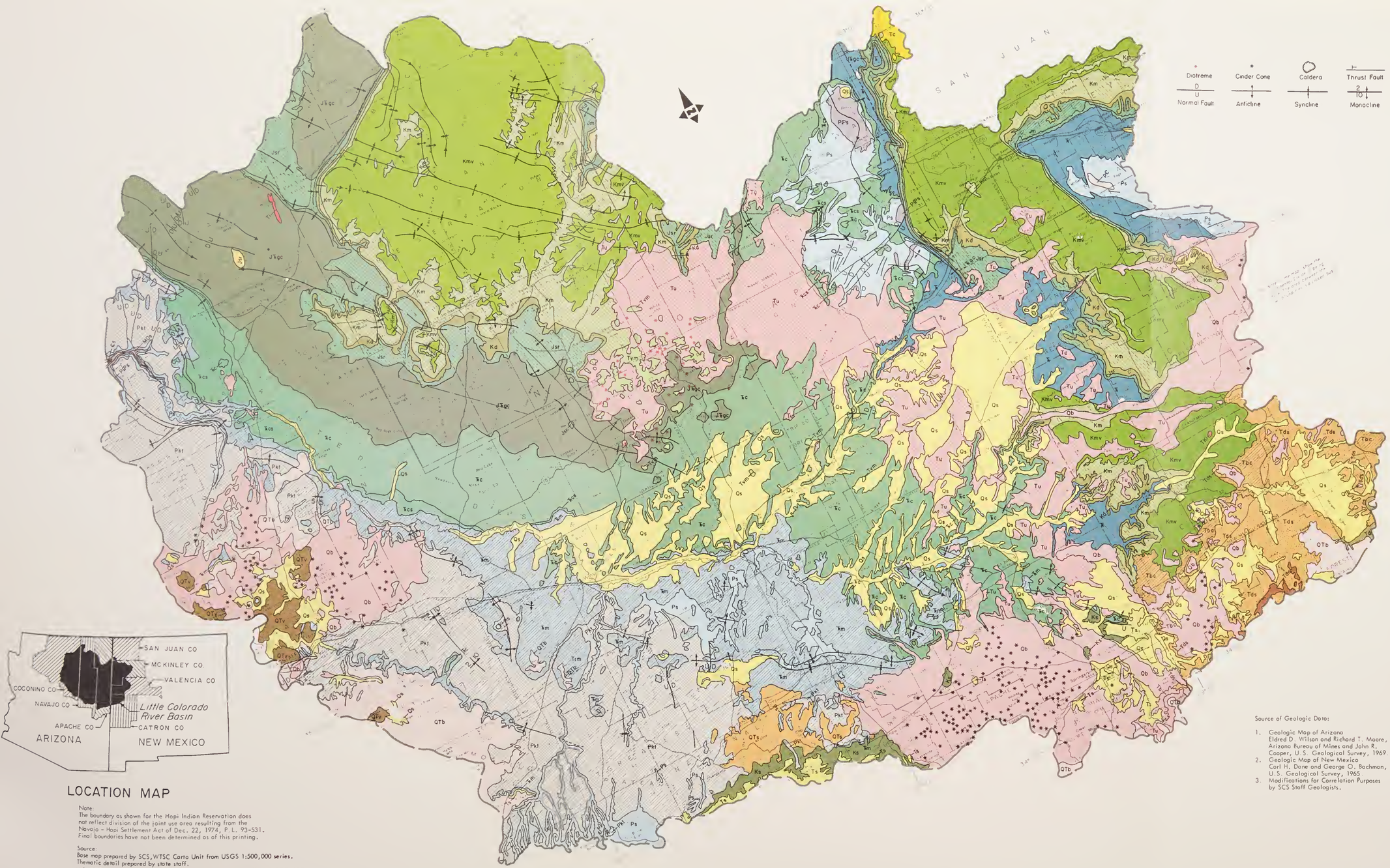
shale, and limestone were deposited. Outcropping formations of this period include the Hermit Shale, Coconino Sandstone, De Chelly Sandstone, Toroweap Formation, and Kaibab Limestone. Exposures of the Hermit Shale are limited to the gorge of the Little Colorado River. The Coconino Sandstone is a very pale orange to grayish-orange, cross-bedded sandstone which is almost white in some areas. It crops out on the Mogollon Mesa and in canyons south and west of Holbrook. In parts of the Basin, it is an important aquifier. The De Chelly Sandstone is a grayish-orange-pink to moderately reddish-orange, fine to medium-grained sandstone. In the Basin, the De Chelly crops out only on the Defiance Plateau and along the lower reaches of the Little Colorado River. The Kaibab Limestone is a yellowish-gray to gray, calcareous sandstone. The Kaibab is rather extensively exposed as an arcuate band extending northwestward from near Show Low to Flagstaff and from about 30 miles north of Flagstaff to Cedar Ridge.

The Zuni Uplift is the only place in the New Mexico portion of the Basin where Paleozoic rock outcrops, with the exception of one small area south of Ojo Caliente in Valencia County.

The Permian sequence consists of the Abo and Yeso Formations, Glorieta Sandstone and San Andres Limestone. The lower portion consists mainly of reddish-brown to pale red sandstones, siltstones, and shales, with several limestone and gypsum beds present in the upper part of the Yeso Formation. The Glorieta is mainly white to buff sandstones and the overlying San Andres is grey and yellow thickbedded limestone to dolomitic limestone.

Following a long erosional period, sediments of the Mesozoic era were deposited under continental, near-shore, and marine conditions. Fluctuations in the environment of deposition were conducive to frequent facies changes. During the Triassaic period, the Moenkopi Formation, Chinle Formation and rocks of the Glen Canyon Group were deposited. The Moenkopi Formation consists mainly of red to reddish-brown to chocolate-colored, interbedded gypsiferous sandstone, shale, and siltstone with some gypsum and limestone beds. Both gradational and abrupt facies changes are common. Cross-bedding is locally pronounced. Badland topography has developed in some areas where the shale beds are exposed. The Moenkopi Formation crops out along the Little Colorado River, its major tributaries, and on the flanks of the Defiance Anticline.

The Chinle Formation is made up of sandstone, claystone, siltstone, mudstone, limestone and conglomerate. This formation contains three members: (1) the Shinarump Conglomerate; (2) the Petrified Forest Member; and (3) the Owl Rock Member. The Shinarump is a light-gray to yellow, coarse-grained to conglomeratic sandstone. The Petrified Forest member consists of variable colored shades of red, blue, gray, yellow, pink and purple mudstone, claystone, siltstone, sandstone, and some conglomerate. Silicified logs are common in this member. The "Petrified Forest" and the "Painted Desert" are within this member. The Owl Rock member consists mainly of interbedded, calcareous sandstone and limestone.



LEGEND

- Qs — Quaternary sedimentary deposits
- Qb — Quaternary volcanic rocks
- Qv — Quaternary - Products of diotremic explosions and other volcanic rocks
- QTs — Tertiary-Quaternary sedimentary rocks
- QTv, QTb — Tertiary-Quaternary volcanic rocks
- Tc, Tu — Tertiary sedimentary deposits
- Ts, Tbc — Tertiary sedimentary rocks
- Tvm, Td, Tdo, Tds, Tb — Tertiary volcanic rock
- Ti — Tertiary dikes, sills and plugs
- TKi — Cretaceous-Tertiary intrusive rock
- Kmv, Km, Ks, Kd — Cretaceous sedimentary rock
- Jm, Jsr — Jurassic sedimentary rocks
- Jrgc — Jurassic-Triassic sedimentary rocks
- Trc, Trcs, Trm, Tr — Triassic sedimentary rocks
- Pkt, Ps — Permian sedimentary rocks
- PPs — Pennsylvanian-Permian sedimentary rocks
- MDs — Devonian and Mississippian sedimentary rocks
- Cs — Cambrian sedimentary rocks
- p€ — Precambrian rocks, undivided

See detailed legend on next page

LOCATION MAP

Note:
The boundary as shown for the Hopi Indian Reservation does not reflect division of the joint use area resulting from the Navajo - Hopi Settlement Act of Dec. 22, 1974, P. L. 93-531. Final boundaries have not been determined as of this printing.

Source:
Base map prepared by SCS, WTSC Carto Unit from USGS 1:500,000 series.
Thematic detail prepared by state staff.

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE USDA-SCS-PORTLAND OR 1980

Source of Geologic Data:

1. Geologic Map of Arizona
   Eldred D. Wilson and Richard T. Moore, Arizona Bureau of Mines and John R. Cooper, U.S. Geological Survey, 1969.
2. Geologic Map of New Mexico
   Carl H. Dane and George O. Bachman, U.S. Geological Survey, 1965.
3. Modifications for Correlation Purposes by SCS Staff Geologists.

GEOLOGY

LITTLE COLORADO RIVER BASIN

ARIZONA AND NEW MEXICO

JANUARY 1980

10 0 10 20 MILES

SCALE 1:1,000,000

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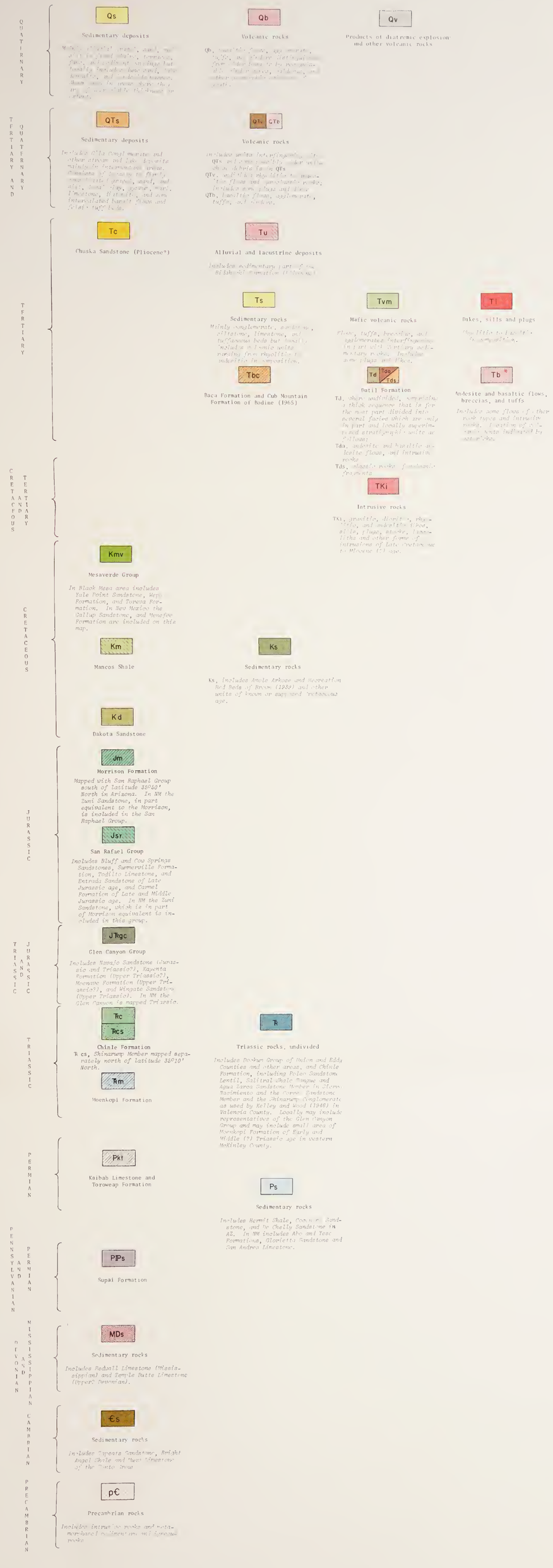
QUATERNARY
Qs
Sedimentary deposits
Qb
Volcanic rocks
Qv
Products of diatremic explosion and other volcanic rocks
TERTIARY AND QUATERNARY
QTs
Sedimentary deposits
QTv
QTb
Volcanic rocks
TERTIARY
Tc
Chuska Sandstone (Pliocene?)
Tu
Alluvial and lacustrine deposits
Ts
Sedimentary rocks
Tvm
Mafic volcanic rocks
Ti
Dikes, sills and plugs
Tbc
Baca Formation and Cub Mountain Formation of Bodine (1965)
Td
Tas
Tds
Datil Formation
Tb *
Andesite and basaltic flows, breccias, and tuffs
CRETACEOUS AND TERTIARY
TKi
Intrusive rocks
CRETACEOUS
Kmv
Mesaverde Group
Km
Mancos Shale
Ks
Sedimentary rocks
Kd
Dakota Sandstone
JURASSIC
Jm
Morrison Formation
Jsr
San Rafael Group
TRIASSIC AND JURASSIC
JTrgc
Glen Canyon Group
TRIASSIC
Trc
Trcs
Chinle Formation
Tr
Triassic rocks, undivided
Trm
Moenkopi Formation
PERMIAN
Pkt
Kaibab Limestone and Toroweap Formation
Ps
Sedimentary rocks
PENNSYLVANIAN AND PERMIAN
PIPs
Supai Formation
MISSISSIPPIAN AND DEVONIAN
MDs
Sedimentary rocks
CAMBRIAN
€s
Sedimentary rocks
PRECAMBRIAN
p€
Precambrian rocks

The Chinle Formation crops out along the north and east side of the Little Colorado River, on the south side of the river in the St. Johns area, north and west of Ganado and around Window Rock.

The Glen Canyon Group is exposed over a large area, almost completely surrounding Black Mesa. The Glen Canyon Group includes formations which may be of both the Triassic and Jurassic periods. Formations within the group, in descending order, include the Navajo Sandstone, the Kayenta Formation, the Moenave Formation and the Wingate Sandstone. The Navajo Sandstone is a light, creamy-yellow, white, pinkish and buff-colored, highly cross-bedded sandstone. The Kayenta Formation is made up of reddish-brown to purplish sandstone, mudstone, and minor limestone. The Moenave Formation consists of red, orange and brown, cross-bedded sandstone and shale. The Wingate Sandstone consists of red-orange to brown sandstone and shale. The sandstone is cross-bedded in part.

Jurassic rocks are exposed on the flanks of Black Mesa, in a small area around Lupton, and along the New Mexico-Arizona border. The lower Jurassic rocks lie unconformably on the Glen Canyon Group. Formations of Jurassic age include the Morrison, Cow Springs Sandstone, and the San Rafael Group. Members of the San Rafael Group are, in descending order, the Bluff Sandstone, the Summerville Formation, Todilto Limestone, Entrada Sandstone and Carmel Formation. Where the Zuni Sandstone is present, the San Rafael Group is divided into the Zuni and the Lower San Rafael.

The Morrison Formation consists of sandstone, mudstone and vari-colored sandy shale. The Cow Springs Formation is a greenish-gray to yellowish-gray, cross-bedded sandstone. The Bluff Sandstone is a gray, cross-bedded sandstone which intertongues with the Cow Springs Sandstone and interfingers with the Summerville and lower portions of the Morrison. The Summerville Formation is a grayish-orange-pink to reddish-brown sandstone which intertongues with the Cow Springs Sandstone. The Todilto Formation is composed of limestone and sandstone. The Entrada Sandstone is an orange-pink to reddish sandstone and red, silty sandstone. The Carmel Formation is a greenish-gray sandstone alternating with grayish-red to brown siltstone.

The Cretaceous age rocks are the most extensive and have the thickest sequence of any of the rock formations in the New Mexico portion of the Basin. The Dakota Sandstone outcrops extensively in New Mexico. It is as far south as Carrizo Creek, north into San Juan County and from the state line to the Continental Divide. The Mancos Shale overlies the Dakota and has a similar areal extent. The Mancos is a gray, yellow or blue silt, clay and fined-grained sandstone. The Dakota is a gray or pale orange sandstone with some shale. The Mesaverde Group overlies the Mancos Shale and is exposed nearly to Red Hill in Catron County and into San Juan County in the Chuska Mountains. The Mesaverde Group in the Basin includes, Gallup Sandstone, Crevasse Canyon Formation, Point Lookout Sandstone, and Menefee Formation.

In Arizona, the Cretaceous rocks are exposed on the edge of the Black Mesa. They also outcrop in a small area north of Lupton. The Mesaverde Group in Arizona is represented by the Toreva, Wepo, and Yale Point

Formations. The Toreva is a gray sandstone with varicolored shale. The Wepo consists of gray to brown siltstone, mudstone and sandstone together with coal. The Yale Point is a yellowish-gray sandstone.

Tertiary age rocks in New Mexico are mainly volcanic or sediment derives from volcanic rocks. The Baca Formation overlies and is similar to the Mesaverde where the contact is gradational. At the contact with the overlying Datil Formation, the Baca consists of sediments of volcanic origin. The Baca is only present in the Basin west of Red Hills in Catron County, along the Arizona-New Mexico state line. The Tertiary Datil Formation is found only in Catron County and consists of volcanics and volcanic derived sediments. There is a very small area of Tertiary basalt mapped in the Washington Pass area of San Juan County.

Tertiary alluvial and lacustrine sediments are mapped in areas south of Gallup to near Zuni Salt Lake in Catron County.

Tertiary age materials in Arizona are represented by the Bidahochi Formation and other unnamed sedimentary rocks. The Bidahochi is a white to light-brown sandstone with minor beds of siltstone and white ash, light-brown to greenish-gray claystone, and sandstone with some bentonite beds. Locally, it contains lava beds. Unnamed Tertiary materials consisting of conglomerate, sandstone, siltstone or limestone with tuffaceous beds and some local volcanic materials crop out south and east of Springerville and southwest of Pinedale.

Mafic volcanic rocks of the Tertiary period are exposed in the Hopi Buttes area around Indian Wells. Volcanic buttes, necks, lava flows and diatremes dot the landscape in this area. Erosion of adjacent materials has left these volcanic remnants, adding to the diversity of the landscape and relief of the area.

Beginning in the Tertiary period and extending well into the Quaternary was a period of considerable volcanic activity in the Basin. Quaternary-Tertiary volcanic activity occurred in the San Francisco volcanic field around Flagstaff, and extended northward to near Gray Mountain and southward and westward to Clear Creek. Rock types include rhyolite, dacite, andesite and latite. Extinct cones, craters, necks, or plugs are numerous in this area. Quaternary-Tertiary sediments consist of scattered outcrops of gravel and conglomerate which cap interstream divides between Show Low and Heber in southern Navajo County. There is an area of Tertiary-Quaternary basalt in the Mangas Mountains in New Mexico in Catron County.

Quaternary rocks are widespread in occurrence in the Basin. Continuing volcanic activity in the San Francisco field led to the accumulation of basalt over a large area. Volcanic activity in the White Mountain volcanic field spread basalt from near Show Low east to near St. Johns. Other areas of exposure are along the Arizona-New Mexico stateline.

Deposits of Quaternary age basalt are present in New Mexico in the southern part of the Basin in scattered areas from the vicinity of Ramah and El Morro National Monument to the Basin's south boundary.

Numerous cinder cones are present in both the San Francisco and White Mountain volcanic fields. Associated volcanic materials include agglomerate, tuff and cinders. The most recent volcanic eruption, dated at about 1064 A.D., created Sunset Crater in the San Francisco volcanic field.

Quaternary sediments, consisting of sand, silt and gravel are present throughout most of the Basin. These are in the form of stream valley deposits and landslide deposits. These deposits vary greatly in texture and thickness. Extensive areas of Quaternary sediments are in the east-central portion of Apache County between the Zuni and Puerco Rivers and north of the Little Colorado River between Holbrook and Winslow.

MINERAL RESOURCES

A large variety of minerals are known to occur in the Arizona portion of the Basin. Areas north of the Little Colorado River, located largely on the Hopi and Navajo Indian Reservations, have the greatest variety and quantities of commercial or potentially commercial mineral resources.

In 1976 the value of mineral production was $3,863,000 in Apache County, $2,532,000 in Coconino County and $38,341,000 in Navajo County (1976, Bureau of Mines).

Sedimentary rocks ranging in age from Triassic to Recent are the most important source rock for minerals in this area. However, the igneous rocks are locally important, especially as a source of aggregate for concrete.

The most important mineral resources, from a commercial viewpoint are coal, uranium, bentonite, vanadium, sand and gravel, and aggregate.

Coal resources in Arizona are classified as bituminous and subbituminous. Most of the coal is found in Cretaceous age strata in the Wepo, Toreva and Dakota Formations. Mining operations are active in the Black Mesa field in Northern Apache and Navajo counties (Photo 1-7). Most of the coal is mined from the Wepo Formation. The coal is a low-ash bituminous coal. In southern Navajo County near Pinedale, a small, low-grade coal field has been operated on a small scale for local use, but is now inactive.

Production from the Black Mesa coal field exceeds 10 million tons per year. In 1971, reserve of coal within the Arizona portion of the Basin, was estimated at 4 billion tons. (11)

There are known uranium resources around Cameron, Chinle and Round Rock. The uranium is found principally in sandstones and conglomerates of continental origin. Approximately 53% of Arizona's production is from the Chinle Formation (Triassic), 28% from the Morrison Formation (Jurassic) and about 19% from various other formations. (2) In 1967 the Arizona Bureau of Mines estimated that Arizona had a reserve of 125,000 tons of ore with an average of at least 0.4% U_3O_8, nearly all of this is in the Colorado Plateau. Vanadium, in the form of vanadium pentoxide, occurs in association with the uranium deposits.

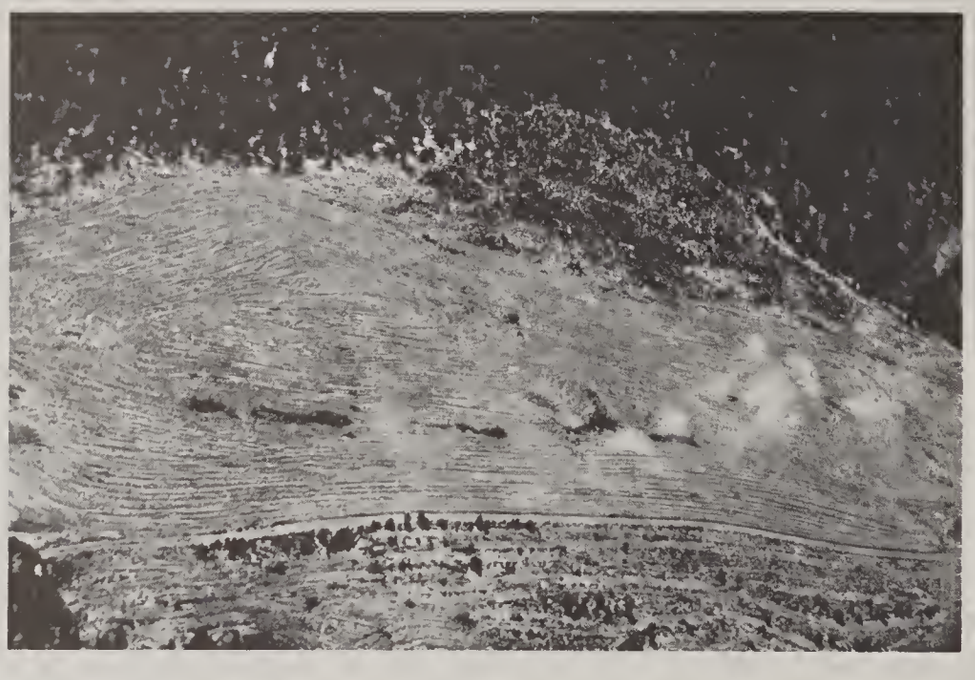

Photo 1-7: Aerial view showing strip mining of coal in the Black Mesa area, Arizona.

Bentonite resources, a clay that was formed from altered volcanic ash, reflect the distribution of tuffaceous (ash bearing) sedimentary strata and are widespread throughout the Basin. These clays are mostly the non-swelling variety. Resources are large, with most deposits being found in the Bidahochi Formation (Pliocene) in east-central Apache County and in the Chinle Formation (Triassic) in Navajo County. Since 1925 one mine in Apache County has produced 90% of Arizona's bentonite. (2) Future production at this mine, however, will be limited because of the increasing amount of overburden that must be removed.

The volume of sand and gravel resources in the Arizona portion of the Basin is not known, except locally. Distribution of these materials is spotty. Usually these deposits are at stream bars and on terraces. Resources of sand are probably great, but coarser aggregate is quite limited. Crushed and broken stone will likely become a major substitute for gravel. In Arizona the annual tonnage of sand and gravel used outranks that of any other mineral resource, and ranks third to copper and molybdenum in total value. A principal producer of sand and gravel is located in Apache County within the study area (Photo 1-8).

There are extensive reserves of pumice and pumicite in the Little Colorado River Basin. These minerals are used for lightweight aggregate; and production will tend to increase as construction increases; but unless new markets for their use can be developed, future production is likely to be minimal.

Photo 1-8: A view of sand and gravel mining operation near Snowflake, Arizona.

Basalt and related rocks are also used for concrete aggregate and for road ballast. Resources are bountiful; large areas range from a few feet to several tens of feet thick. Production is limited because of high transportation cost, and most will be used locally.

Other mineral resources of commercial value in the Basin include helium, halite, flagstone, dimension stone, crushed aggregate, limestone for cement and burnt lime, bleaching and structural clays, diatomite, iron, arsenic, cadmium, molybdenum, cobalt, manganese, rare earths, copper, lead, opal, agate, petrified wood, gypsum, silica (industrial), dolomite, kaolin, pozzolian and rock for use in riprap. The occurence and distribution of these resources on the Navajo and Hopi Indian Reservations were evaluated under contract for the Bureau of Indian Affairs as provided in the Navajo-Hopi Indian Rehabilitation Act of 1950. Published reports (References 7,8,11) suggest a potential for commercial use of a number of these resources. Decisions regarding development should be based upon an up-to-date evaluation of available reserves, environmental impacts, operational costs, and market values.

In New Mexico, coal, uranium, clay, building stone, salt, asphaltic sandstone, basalt, sand, and gravel have been mined in the Little Colorado River Basin. Today, the largest mining operation is coal; uranium is second. Coal fields underlie extensive areas of the New Mexico portion of the Basin. There are two major fields: the Gallup-Zuni and the Salt Lake Coal Fields. They extend both north and south for nearly the total width of the New Mexico portion of the Basin.

The Gallup-Zuni field extends from the Chuska Mountains, at the northern edge of the Basin, to about 12 miles into Valencia County, at the southern edge. The width of the field varies from about six to twenty miles. Coal is found in the Gallup Sandstone, Dilco, and Givson Coal Members of the Crevasse Canyon Formation and the Cleary Coal Member of the Menefee Formation. These are all in the Cretaceous age, Mesaverde Group. The Mesaverde coals range from subbituminous B to high-volatile B bituminous.

Since the 1880's, about 30 mines have supplied coal to the railroads. Current mining is mainly for energy production. The McKinley Mine near Window Rock will supply up to 3 million tons per year to the Arizona Public Service Company. The Carbon Coal Company also supplies about 1.6 million tons to the same company. There are, at present, four strip mine operations within the Basin in this field, and production is near 7 million tons annually.

The Salt Lake Field is separated from the Gallup-Zuni Field by a southeast trending fault. "Coal-bearing rocks crop out in a west-facing arcuate belt centered around (Zuni) Salt Lake." (43) The Salt Lake Field is located in Valencia and Catron Counties in the Zuni Salt Lake-Fence Lake area. It extends into Arizona west of Fence Lake. One arm extends southwest from Salt Lake to the vicinity of Red Hill in Catron County. There has been little field exploration and no mining reported in this field. Beds of coal up to seven feet thick have been reported. The 1905 New Mexico Inspector of Mines Annual Report indicated a reserve in the Salt Lake Field of about 320 million tons.

Uranium in the New Mexico portion of the Basin is principally in the Gallup mining area of the Grants Mineral Belt. The ores are mainly in the Westwater Canyon and Brushy Basin Member of the Morrison Formation of Jurassic age and the Dakota Sandstone of Cretaceous age. Deposits consist of carbonaceous sandstone, carbonaceous shale, and lignite.

There are seven uranium mines in the Gallup area. United Nuclear Corporation operates a 2000 ton per day uranium mill at its Church Rock Mine. Oil and gas are doubtful resources in the Basin. There are no producing oil or gas fields in the Basin in New Mexico, and potential for development is low. Clay has been mined from shales in the Mancos and Lewis Formation and in the Mesaverde Group, all are of Cretaceous age. Clays have also been obtained from alluvial beds and unconsolidated Tertiary shales. Building stone has been quarried from the Gallup Sandstone of the Cretaceous age, Mesaverde Group and Triassic Wingate Sandstone.

Salt has been produced from brine in the Basin for centuries. The Zuni Salt Lake has been utilized by the Zuni Indians and probably earlier Indians prior to the development of the Pueblo culture in the area. Coronado mentioned it when he passed through the Basin in 1540. The Zuni Indians still harvest salt, annually. Salt Lake is significant in the Zuni religion. At the present time a land exchange is being negotiated between the State, the Bureau of Land Management, and the Bureau of Indian Affairs, so the lake can be held in trust for the Zuni.

Sand and gravel are found in alluvial deposits in various parts of the New Mexico portion of the Basin. A plant just west of Gallup crushes basalt for use as aggregate in the manufacturing of asphalt.

SOILS

The soils of the Basin have been separated into 28 map units. These are shown in Table 1 and on the General Soil Map, following page 1-30. Each map unit is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. The map units are named by grouping soil components at the Great Group level. The Great Group is one category of the soil Taxonomy--a basic system of soil classification for making and interpreting soil surveys. The soils making up a map unit can occur in other units, but in a different pattern. The soils in any one map unit may differ from place to place and from one map unit to the next. Major differences include slope, depth, drainage and other characteristics that might affect their use.

A definition and brief description of each component (Great Group) is given in the Glossary page 1-22. Additional information for each component and mapping unit is given in Table 1, pages 1-23 through 1-30.

The General Soil Map can be used to compare the suitability of large areas for general land uses, but should not be used for detailed planning. Because of its scale, it should not be used for single-farm planning or for site selection for roads, houses or other types of structures. It can be used to identify large scale areas that "are" or "are not" suited for selected purposes.

The local Soil Conservation Service, Forest Service, or the Bureau of Indian Affairs should be contacted to determine the availability of more detailed soil surveys should these be needed. A more complete description of the soils that are described in this report is available at the Water Resource Planning Staff Office, Soil Conservation Service, Phoenix, Arizona.

The map units in the Little Colorado River Basin have been grouped into four broad categories for interpretive purposes. These groups are shown in Table 1 and are entitled as follows: (1) Light Colored Soils of the Warm Desertic Region-Thermic, (2) Light Colored Soils of the Cool Plateau Region-Mesic, (3) Light and Moderately Dark Colored Soils of the Cool Plateau Region-Mesic, and (4) Moderately Dark and Dark Colored Soils of the Cool to Cold Mountain Region-Mesic and Frigid.

From the group titles, it is indicated that the soils have been classified largely with respect to climate and to their position on the landscape. Soil colors also have been used in the classification. The color of soils tend to increase in intensity from the lower elevations to the mountains. Generally, the darkest soils of the mountains are the result of an accumulation of humus and/or organic matter resulting from higher precipitation and cooler temperatures.

The first group of soils listed has only one map unit, (Unit No. 1 on General Soil Map). This unit occurs along the Little Colorado River near its junction with the Colorado River. The soils formed primarily in materials derived from sandstone, shale, and limestone. They are shallow and moderately deep, loamy, sloping to steep soils, and rock outcrop of the canyons and mesas. Elevations range from 3,000 to 6,000 feet. The area is in a thermic climatic zone with average air temperatures ranging from 55° to 64° F. The average annual precipitation ranges from 6 to 12 inches. Vegetation is desert shrubs and grasses, with juniper and pinon at the higher elevations.

Other pertinent data relative to these soils are shown in Table 1; general descriptions are given in tbe Glossary. Major uses of these soils include recreation, wildlife habitat, and limited grazing. The contrasting hues of red, gray, and white bedrock, and vastness of the relief provide unparallel scenic grandeur, making these areas extremely popular as a tourist attraction.

The "Light Colored Soils of the Cool Plateau Region" also are formed in materials derived from sandstone, shale and limestone. Most soils in this group have been modified and transported by wind and water. This group has 13 map units (Units 7 through 20 on General Soil Map). They occur throughout the Colorado Plateau.

Elevations range from 4,400 to 7,500 feet. The climate is mesic with average annual air temperatures of 47° to 59° F. The average annual precipitation varies from 6 to 15 inches over the region.

The soils of this group cover the full range of texture from clayey, to loamy to sandy; and the topography varies from level to steep, including both floodplains and dissected hills. The landscape and other pertinent data for these soils are given in Table 1, and general descriptions are given in the Glossary.

Since this soil group is very broad, land uses and vegetative cover also vary widely. Major uses include irrigated cropland, rangeland, recreation, wildlife habitat, and mining. Vegetative cover includes desert shrubs, grasses, pinon and juniper. In some areas, such as rock outcrops, no vegetative cover exist.

The "Light and Moderately Dark Colored Soils of the Cool Plateau Region" are located mainly in the western, central and southeastern parts of the Little Colorado River Basin. Elevations range from 5,000 to 7,800 feet. The climate is mesic with average air temperatures ranging from 46° to 55° F. The average annual precipitation ranges from 10 to 18 inches.

This soil group has five (5) map units (units 21 through 25 on General Soil Map). The soils formed in materials derived primarily from volcanic rock and limestone. The texture and landscape positions are similar to those described for the second soil group. The texture ranges from clayey to loamy to sandy. The landscape varies from flood plains to hill slopes, with slopes varying from level flood plains to steep escarpments. Depth to rock varies from zero to more than 60 inches.

Table 1 lists individual soils for this group and general descriptions are given in the Glossary. Vegetative cover includes grasses, shrubs, pinon and juniper. Major uses include grazing, wildlife habit and recreation. Some soils of the flood plains are used for irrigation.

The final soil group is made up of the "Moderately Dark and Dark Colored Soil of the Cool to Cold Mountain Region". These soils are in the southwestern, southern, southeastern and northeastern parts of the Basin. Elevations range from 6,000 to 11,000 feet. The climate is mesic and frigid. Average air temperatures range from 36° to 52° F, and the average annual precipitation ranges for 14 to 35 inches.

This soil group has nine (9) map units (units 26 through 35 on General Soil Map). The soils formed in materials weathered from limestone, sandstone, and basalt. The soil texture varies from loams to clays. Depth varies from 8 to more than 60 inches to bedrock or hard pan. The terrain grades from gentle, rolling, undulating hills to very steep mountain slopes. The landscape is classified as hill-slopes, mountain slopes, mountain meadows, and canyon walls.

A list of soils for this group is given in Table 1, and general descriptions are given in the Glossary. Vegetative cover includes shrubs and grasses; pinon-juniper woodland, and ponderosa pine. True firs, aspen and spruce forests occur at the higher elevations. Major uses include grazing, wildlife habitat, recreation, and timber.

SOILS GLOSSARY

Argiborolls: The soils of the cool to cold subhumid and humid regions. They have dark colored surfaces and well developed subsoils. Vegetation is normally coniferous forest.

Argiustolls: The soils of the subhumid to semiarid regions. They have dark colored surfaces, well developed subsoils, and high base saturation. Vegetation is normally grasses.

Badland: Steep or very steep barren land, usually not stony, dissected by many intermittent drainage channels. Local relief generally ranges between 25 and 500 feet. Geological erosion is active.

Chromusterts: These soils are clayey and have deep wide cracks during the dry seasons, usually during the summer. Vegetation is normally juniper and grasses.

Calciustolls: The soils of the subhumid to semiarid regions. They have dark colored surfaces, are calcareous throughout and have zones of calcium carbonate accumulation. Vegetation is normally grasses.

Camborthids: These are dry soils of arid regions with only slight evidence of soil development. These soils are commonly on erosion surfaces. Vegetation is normally sparse.

Cryoborolls: The soils of the cold humid regions. They have dark colored surfaces. These soils have either mixed coniferous vegetation, or if above timberline has only grasses.

Eutroboralfs: The soils of the cool, subhumid regions. They have light colored surfaces, well developed subsoils, and moderate to high base saturation. Vegetation is normally coniferous or mixed forest.

Haplargids: Dry soils of arid regions that have weakly to strongly developed subsoils of clay accumulation. Vegetation is mainly sparse and ranges from shrubs to grass.

Haplustalfs: The soils of the subhumid to semiarid regions. They have light colored surfaces, well developed subsoils, and moderate to high base saturation. Vegetation is normally a mixture of woodland and grasses.

Haplustolls: The soils of the subhumid to semiarid regions. They have dark colored surfaces and weakly developed subsoils. Vegetation is normally grasses.

Rock outcrop: Areas of exposed bare bedrock.

Torrifluvents: These are dry and/or salty soils of arid regions without evidence of development. They formed in recent water-deposited sediments on flood plains and alluvial fans. They are flooded but not for long periods. Vegetation is sparse.

Torriorthents: These are dry and/or salty soils of arid regions without evidence of development. The soils are on recent erosional surface. Vegetation is normally sparse.

Torripsamments: These are the sandy soils of arid climates. They are sands of shifting or stabilized sand dunes. Vegetation is normally sparse.

Ustochrepts: The soils of the subhumid regions that usually have light colored surfaces and evidence of the beginning stages of soil development. Vegetation is normally a mixture of woodland and grasses.

Ustorthents: The soils of the subhumid regions without evidence of development. The soils are usually on recent erosional or depositional surfaces. Vegetation is normally a mixture of woodland and grasses.

TABLE 1-1: SOILS OF THE LITTLE COLORADO RIVER BASIN
(Soil Qualities and Features)
Arizona and New Mexico

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Map Symbol	Mapping Unit	Approx. Extent Within River Basin	Approx. Extent Within Map Unit	Depth to Rock or Pan	Landscape	Slope	Elevation	Precip-itation	Air Temper-ature	Frost-free Season	Vegetation	Major Uses
		%	%	*inches*		%	*feet*	*inches*	°F	*days*		
LIGHT COLORED SOILS OF THE WARM DESERTIC REGION - THERMIC												
1	Torriorthents-Camborthids-Rock outcrop	0.27										
	Torriorthents	-	65	10-40	Hillslopes	15-75	3,000-6,000	6-12	55-64	165-200	Desert shrubs & grasses	Recreation, wild-life habitat, grazing
	Camborthids	-	15	10-40	Hillslopes	5-30	3,000-5,000	6-12	55-64	165-200	Desert shrubs & grasses	Recreation, wild-life habitat, grazing
	Rock outcrop	-	15	0-5	Canyon walls	>35	3,000-6,000	6-12	55-64	165-200	None	Recreation
LIGHT COLORED SOILS OF THE COOL PLATEAU REGION - MESIC												
7 1/	Badland-Torriorthents-Torrifluvents	6.74										
	Badland	-	40	0-4	Hillslopes	30-60	4,600-6,000	6-12	51-56	130-170	None	Recreation
	Torriorthents	-	25	10-20	Ridges	2-8	4,600-6,000	6-12	51-56	130-170	Grasses & shrubs	Rangeland, wild-life habitat, recreation
	Torrifluvents	-	25	>60	Flood plain	0-2	4,600-6,000	6-12	51-56	130-170	Grasses & shrubs	Rangeland, wild-life habitat, recreation
8	Torriorthents-Torrifluvents	7.79										
	Torriorthents	-	75	4-20	Hillslopes	1-15	4,400-6,500	6-10	49-59	130-180	Shrubs & grasses	Rangeland, wild-life habitat
	Torrifluvents	-	15	>60	Flood plain	0-2	4,400-6,500	6-10	49-59	130-180	Shrubs & grasses	Rangeland, wild-life habitat

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		%	%	*inches*		%	*feet*	*inches*	°F	*days*		
9	Torripsamments-Torriorthents-Rock outcrop	4.58										
	Torripsamments	-	35	>60	Stabilized dunes	2-8	5,000-7,000	6-10	50-58	125-170	Desert shrubs & grasses	Rangeland, wildlife habitat, recreation
	Torriorthents	-	35	>60	Hillslopes	2-8	5,000-7,000	6-10	50-58	125-170	Desert shrubs & grasses	Rangeland, wildlife habitat, recreation
	Rock outcrop	-	15	0-4	Canyon walls	2-60	5,000-7,000	6-10	50-58	125-170	None	Recreation
10	Torrifluvents	-	70	>60	Flood plain, alluvial fans	0-2	4,600-5,700	6-10	50-57	155-175	Shrubs & grasses	Rangeland, irrigated cropland, wildlife habitat, urban
12	Torriorthents-Camborthids-Torrifluvents	12.78										
	Torriorthents	-	50	>20	Hillslopes	2-8	5,000-6,800	6-12	50-56	130-170	Shrubs & grasses	Rangeland, wildlife habitat
	Camborthids	-	30	>60	Hillslopes	2-8	5,000-6,800	6-12	50-56	130-170	Shrubs & grasses	Rangeland, wildlife habitat
	Torrifluvents	-	15	>60	Alluvial fans & flood plain	0-2	5,000-6,800	6-12	50-56	130-170	Shrubs & grasses	Rangeland, wildlife habitat
13	Torriorthents[2]-Haplargids[3]-Rock outcrop	6.15										
	Torriorthents	-	60	6-20	Hillslopes	2-8	4,600-6,600	10-14	50-58	130-170	Juniper, pinyon & grasses	Grazing, wildlife habitat, recreation
	Haplargids	-	15	10-20	Plains	1-3	4,600-6,600	10-14	50-58	130-170	Juniper, pinyon & grasses	Grazing, wildlife habitat, recreation
	Rock outcrop	-	15	0-4	Canyon walls	30-60	4,600-6,600	10-14	50-58	130-170	None	Recreation

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		%	%	*inches*		%	*feet*	*inches*	°F	*days*		
14	Torriorthents-Rock outcrop-Haplargids[2/][3/]	4.84										
	Torriorthents	-	40	4-20	Hillslopes	5-75	5,000-7,000	10-15	47-56	130-175	Juniper, pinyon, shrubs, grasses	Grazing, wildlife habitat, mining, recreation
	Rock outcrop	-	20	0-4	Canyon walls	10-60	5,000-7,000	10-15	47-56	130-175	None	Mining, recreation
	Haplargids	-	20	8-20	Hillslopes	8-15	5,000-7,000	10-15	47-56	130-175	Juniper, pinyon, shrubs, grasses	Grazing, wildlife habitat, mining, recreation
15	Rock outcrop-Torriorthents-Haplargids	4.09										
	Rock outcrop	-	30	0-4	Canyon walls	30-70	5,800-6,900	10-14	47-54	120-150	None	Recreation, wildlife habitat, rangeland
	Torriorthents	-	30	8-20	Hillslopes	3-20	5,800-6,900	10-14	47-54	120-150	Grasses, shrubs, juniper	Rangeland, wildlife habitat, recreation
	Haplargids	-	20	25-40	Plains	1-8	5,800-6,900	10-14	47-54	120-150	Grasses, shrubs, juniper	Rangeland, wildlife habitat, recreation
16	Haplargids-Torripsamments-Torrifluvents	14.68										
	Haplargids	-	55	>60	Plains	1-3	4,800-7,000	10-14	48-56	125-175	Grasses, shrubs	Rangeland, wildlife habitat, irrigated cropland
	Torripsamments	-	20	>60	Stabilized dunes	2-8	4,800-7,000	10-14	48-56	125-175	Grasses, shrubs	Rangeland, wildlife habitat, irrigated cropland
	Torrifluvents	-	15	>60	Flood plain	0-3	4,800-7,000	10-14	48-56	125-175	Grasses, shrubs	Rangeland, wildlife habitat, irrigated cropland

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		%	%	*inches*		%	*feet*	*inches*	°F	*days*		
17	Torriorthents-Rock outcrop-Torriorthents	0.94										
	Torriorthents	-	55	4-20	Hillslopes	3-15	6,200-6,800	10-12	48-50	120-135	Grasses & shrubs	Rangeland, wildlife habitat, urban
	Rock outcrop	-	25	0-4	Escarpments	30-60	6,200-6,800	10-12	48-50	120-135	None	Recreation, wildlife habitat
18	Camborthids-Torriorthents	1.39										
	Camborthids	-	50	>20	Plains	1-8	6,400-6,900	10-13	48-50	120-135	Grasses & shrubs	Rangeland, wildlife habitat
	Torriorthents	-	30	6-20	Hillslopes	3-12	6,400-6,900	10-13	48-50	120-135	Grasses & shrubs	Rangeland, wildlife habitat
19	Haplargids-Torriorthents-Rock outcrop	4.01										
	Haplargids	-	35	>20	Plains	1-8	6,200-7,000	12-14	48-50	120-135	Grasses	Rangeland, wildlife habitat
	Torriorthents	-	20	6-20	Hillslopes	3-15	6,200-7,000	12-14	48-50	120-135	Grasses, shrubs, juniper	Rangeland, wildlife habitat
	Rock outcrop	-	15	0-4	Canyon walls	30-60	6,200-7,000	12-14	48-50	120-135	None	Recreation, wildlife habitat
20	Haplargids	1.46	70	>60	Plains	1-8	6,900-7,500	12-14	47-49	120-130	Grasses, shrubs, juniper	Rangeland, wildlife habitat
LIGHT AND MODERATELY DARK COLORED SOILS OF THE COOL PLATEAU REGION - MESIC												
21	Argiustolls-Haplustalfs	0.95										
	Argiustolls	-	60	20-40	Hillslopes	8-15	6,200-7,200	12-18	47-54	120-150	Pinyon, juniper, grasses, shrubs	Grazing, wildlife habitat, recreation
	Haplustalfs	-	25	10-20	Hillslopes	1-8	6,200-7,200	12-18	47-54	120-150	Pinyon, juniper, grasses, shrubs, & some ponderosa pine	Grazing, wildlife habitat, recreation

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Map Symbol	Mapping Unit	Approx. Extent Within River Basin	Approx. Extent Within Map Unit	Depth to Rock or Pan	Landscape	Slope	Elevation	Precip-itation	Air Temper-ature	Frost-free Season	Vegetation	Major Uses
		%	%	*inches*		%	*feet*	*inches*	°F	*days*		
22	Calciustolls-Haplustolls-Argiustolls	5.26										
	Calciustolls	-	40	6-20	Plains	2-8	5,000-7,400	10-16	47-55	120-160	Grasses	Rangeland, wildlife habitat, recreation
	Haplustolls	-	25	12-26	Hillslopes	8-15	5,000-7,400	10-16	47-55	120-160	Grasses, juniper, pinyon	Rangeland, wildlife habitat, recreation
	Argiustolls	-	20	10-20	Basalt flows	2-8	5,000-7,400	10-16	47-55	120-160	Grasses, juniper, pinyon	Rangeland, wildlife habitat, recreation
23	Argiustolls-Chromusterts	1.59										
	Argiustolls	-	65	10-40	Hillslopes	2-15	6,500-7,200	12-14	47-50	120-135	Grasses, juniper	Rangeland, wildlife habitat, recreation
	Chromusterts	-	15	40-60	Plains	0-5	6,500-7,200	12-14	47-50	120-135	Grasses, juniper	Rangeland, wildlife habitat, recreation
24	Torrifluvents-Haplargids-Haplustolls	2.17										
	Torrifluvents	-	35	>60	Flood plain	0-3	6,200-7,400	11-13	47-51	120-140	Grasses, shrubs	Rangeland, wildlife habitat, irrigated cropland
	Haplargids	-	20	>60	Plains	1-8	6,200-7,400	11-13	47-51	120-140	Grasses, shrubs	Rangeland, wildlife habitat, irrigated cropland
	Haplustolls	-	15	>60	Valley floors	0-3	6,200-7,400	12-15	47-51	120-140	Grasses, shrubs	Rangeland, wildlife habitat, irrigated cropland

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		%	%	*inches*		%	*feet*	*inches*	°F	*days*		
25	Argiustolls-Haplustalfs-Rock outcrop	3.51										
	Argiustolls	-	45	10-40	Plains	1-8	7,100-7,800	13-16	46-50	120-130	Juniper, pinyon, grasses, shrubs	Grazing, wildlife habitat, recreation
	Haplustalfs	-	20	10-60	Hillslopes	0-15	7,100-7,800	13-16	46-50	120-130	Juniper, pinyon, grasses, shrubs	Grazing, wildlife habitat, recreation
	Rock outcrop	-	15	0-4	Escarpments	30-60	7,100-7,800	13-16	46-50	120-130	None	Recreation, wildlife habitat
	MODERATELY DARK AND DARK-COLORED SOILS OF THE COOL TO COLD MOUNTAIN REGION - MESIC AND FRIGID											
26	Haplustolls-Haplustalfs [4/]	0.31										
	Haplustolls	-	65	6-20	Hillslopes	2-45	6,200-6,800	14-16	48-52	125-140	Pinyon, juniper, shrubs, grasses	Grazing, wildlife habitat, recreation
	Haplustalfs	-	20	20-40	Hillslopes	8-15	6,200-6,800	14-16	48-52	125-140	Pinyon, juniper, shrubs, grasses	Grazing, wildlife habitat, recreation
27	Argiustolls-Haplustalfs-Ustochrepts	0.68										
	Argiustolls	-	35	>60	Hillslopes	8-15	6,000-6,500	18-20	48-52	125-135	Woodland, shrubs, grasses	Grazing, wildlife habitat, recreation
	Haplustalfs	-	35	>60	Hillslopes	8-15	6,000-6,500	18-20	48-52	125-135	Woodland, shrubs, grasses	Grazing, wildlife habitat, recreation
	Ustochrepts	-	20	>60	Hillslopes	8-15	6,000-6,500	18-20	48-52	125-135	Woodland, shrubs, grasses	Grazing, wildlife habitat, recreation

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		%	%	*inches*		%	*feet*	*inches*	°F	*days*		
28	Eutroboralfs-Haplustalfs-Ustorthents	1.19										
	Eutroboralfs	-	35	>60	Mountain slopes	15-50	6,500-7,100	19-23	44-46	100-130	Woodland, shrubs, grasses	Timber, grazing, wilflife habitat, recreation
	Haplustalfs	-	30	20-40	Mountain slopes	8-15	6,500-7,100	19-23	45-50	100-130	Woodland, shrubs, grasses	Timber, grazing, wildlife habitat, recreation
	Ustorthents	-	25	8-20	Mountain slopes	15-75	6,500-7,100	19-23	45-50	100-130	Woodland, shrubs, grasses	Timber, grazing, wildlife habitat, recreation
29	Rock outcrop-Haplustolls-Argiustolls	0.38										
	Rock outcrop	-	35	0-4	Canyon walls	30-70	6,000-7,500	16-20	48-52	120-140	None	Recreation,wildlife habitat
	Haplustolls	-	25	6-20	Hillslopes	5-30	6,000-7,500	16-20	48-52	120-140	Pinyon, juniper, shrubs, grasses	Grazing, wildlife habitat, recreation
	Argiustolls	-	25	10-20	Hillslopes	5-30	6,000-7,500	16-20	48-52	120-140	Pinyon, juniper, shrubs, grasses	Grazing, wildlife habitat, recreation
30	Eutroboralfs-Argiborolls	0.92										
	Eutroboralfs	-	35	20-40	Mountain slopes	5-25	7,500-8,500	20-24	42-46	100-120	Ponderosa pine, shrubs, grasses	Timber, grazing, wildlife habitat, recreation
	Argiborolls	-	25	10-40	Mountain slopes	10-40	7,500-8,500	20-24	42-46	100-120	Ponderosa pine, shrubs, grasses	Timber, grazing, wildlife habitat, recreation

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		%	%	*inches*		%	*feet*	*inches*	°F	*days*		
31	Eutroboralfs-Ustorthents											
	Eutroboralfs	-	50	10-50	Mountain slopes	2-15	7,000-9,000	16-22	41-46	85-110	Ponderosa pine, shrubs, grasses	Timber, grazing, wildlife habitat, recreation
	Ustorthents	-	30	10-20	Mountain slopes	15-40	7,000-9,000	16-22	41-46	85-110	Ponderosa pine, shrubs, grasses	Timber, grazing, wildlife habitat, recreation
32	Argiborolls-Cryoborolls-Ustorthents 5/											
	Argiborolls	-	40	20-60	Mountain slopes	15-40	7,000-9,000	20-30	38-45	70-110	Coniferous forest	Timber, grazing, wildlife habitat, recreation
	Cryoborolls	-	20	>20	Mountain slopes	8-15	8,000-10,000	20-30	36-42	50-75	Coniferous forest	Timber, grazing, wildlife habitat, recreation
	Ustorthents	-	20	15-20	Mountain slopes	10-25	7,000-9,000	20-30	38-45	70-110	Coniferous forest	Timber, grazing, wildlife habitat, recreation
33	Eutroboralfs 6/	-	90	>20	Mountain slopes	2-15	7,000-8,000	18-30	41-46	85-125	Coniferous forest	Timber, grazing, wildlife habitat, recreation
35	Cryoborolls 7/	-	85	>30	Mountain meadows & slopes	1-8 2-30	8,000-11,000	24-35	36-45	50-75	Grasses, shrubs, conifers	Grazing, wildlife habitat, recreation

1/ Numbers in the legend are not continuous.
2/ Some Ustorthents are included in areas with higher precipitation.
3/ Some Haplustalfs are included in areas with higher precipitation.
4/ Some Ustochrepts are included.
5/ Some Cryorthents occur in the alpine tundra of the San Francisco peaks. Some Vitrandepts occur around Sunset Crater National Monument.
6/ Some Glossoboralfs occur on side slopes of canyons. The slopes range up to 40 percent.
7/ Argiborolls, Glossoboralfs, and Cryoboralfs make up a significant portion of this mapping unit.

LOCATION MAP

LEGEND

LIGHT COLORED SOILS OF THE WARM DESERTIC REGION - THERMIC

1. Torriorthents-Camborthids-Rock outcrop
Shallow and moderately deep loamy 1/, sloping to steep soils and Rock outcrop of the canyons and mesas.

LIGHT COLORED SOILS OF THE COOL PLATEAU REGION - MESIC

7. Badland-Torriorthents-Torrifluvents
Badland and shallow and deep, loamy and clayey, nearly level to very steep soils of dissected hills and flood plains.

8. Torriorthents-Torrifluvents
Shallow and deep, loamy, level to rolling soils of hills and flood plains.

9. Torripsamments-Torriorthents-Rock outcrop
Deep, sandy and loamy, level to rolling soils and rock outcrop of the plains and hills.

10. Torrifluvents
Deep, loamy and clayey, level soils of the flood plains and alluvial fans.

12. Torriorthents-Camborthids-Torrifluvents
Moderately deep to deep, loamy, level to undulating soils of the uplands and flood plains.

13. Torriorthents-Haplargids-Rock outcrop
Shallow, loamy and clayey, level to rolling soils and rock outcrop of the plateaus.

14. Torriorthents-Rock outcrop-Haplargids
Shallow, loamy and clayey, sloping to steep soils and rock outcrop of the hills.

15. Rock outcrop-Torriorthents-Haplargids
Rock outcrop and shallow to deep, loamy, level to steep soils on the canyons and plains.

16. Haplargids-Torripsamments-Torrifluvents
Deep, loamy and sandy, level to undulating soils of the plains and flood plains.

17. Torriorthents-Rock outcrop
Shallow, loamy, sloping to rolling soils and rock outcrop of the dissected plateaus.

18. Camborthids-Torriorthents
Shallow to deep, loamy and clayey, undulating to sloping soils of the plains and hills.

19. Haplargids-Torriorthents-Rock outcrop
Shallow to deep, loamy and clayey, level to rolling soils and rock outcrop of the plains and hills.

20. Haplargids
Deep, loamy and clayey, level to sloping soils of the plains.

LIGHT AND MODERATELY DARK COLORED SOILS OF THE COOL PLATEAU REGION - MESIC

21. Argiustolls-Haplustalfs
Shallow to moderately deep, clayey, undulating to sloping soils of the hills.

22. Calciustolls-Haplustolls-Argiustolls
Shallow to moderately deep, loamy and clayey, undulating to slo soils of basalt controlled mesas and cinder cones.

23. Argiustolls-Chromusterts
Shallow to deep, clayey, nearly level to sloping soils of basa plains and hills.

24. Torrifluvents-Haplargids-Haplustolls
Deep, loamy and clayey, level to sloping soils of the flood pl and plains.

25. Argiustolls-Haplustalfs-Rock outcrop
Shallow to deep, loamy and clayey, level to sloping soils and outcrop of basalt-capped mesas.

MODERATELY DARK AND DARK-COLORED SOILS OF THE COOL TO COLD MOU REGION - MESIC AND FRIGID

26. Haplustolls-Haplustalfs
Shallow to moderately deep, loamy and clayey, undulating to st soils of the hills.

27. Argiustolls-Haplustalfs-Ustochrepts
Deep, loamy and clayey, sloping to rolling soils of hills.

28. Eutroboralfs-Haplustalfs-Ustorthents
Shallow to deep, loamy and clayey, undulating to very steep so of mountains.

29. Rock outcrop-Haplustolls-Argiustolls
Shallow, loamy and clayey, rolling to very steep soils of hill

30. Eutroboralfs-Argiborolls
Shallow to moderately deep, loamy and clayey, sloping to steep soils of the mountains.

31. Eutroboralfs-Ustorthents
Shallow to deep, loamy and clayey, sloping to steep soils of the mountains.

32. Argiborolls-Cryoborolls-Ustorthents
Moderately deep to deep, loamy, sloping to steep soils of the mountains.

33. Eutroboralfs
Moderately deep and deep, clayey, level to sloping soils of th mountains.

35. Cryoborolls
Deep and moderately deep, loamy and clayey, level to sloping s of the mountain meadows.

1/ Texture refers to the subsoil or underlying layer between 10-4 inches or a restricting layer.

Note:
The boundary as shown for the Hopi Indian Reservation does not reflect division of the joint use area resulting from the Navajo-Hopi Settlement Act of Dec. 22, 1974, P. L. 93-531. Final boundaries have not been determined as of this printing.

Source:
Base map prepared by SCS, WTSC Carto Unit from USGS 1:500,000 series.
Thematic detail compiled by state staff.
U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE USDA SCS PORTLAND OR 1979

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

GENERAL SOIL MAP

LITTLE COLORADO RIVER BASIN

ARIZONA AND NEW MEXICO

1979

10 0 10 20 MILES

SCALE 1:1,000,000

M7-EN-

LAND OWNERSHIP AND ADMINISTRATION

The lands within the Little Colorado River Basin were obtained by the United States from Mexico by the "Treaty of Guadalupe-Hidalgo" in 1848. This "accession from Mexico" included most of the Colorado River Region north of the Gila River. Spanish land grants within the area were recognized by the United States Government as private lands; all other lands became a part of the Nation's public domain. The only land grant in the Basin was the Zuni Pueblo (1689). Withdrawals from the public domain for national parks, national forest, Indian reservations, and other purposes have created the current pattern of ownership and land administration.

Private ownership of land within the Basin varies from 21.31% in Arizona to 30.27% in New Mexico, with an average for the Basin of 23.07%. Basinwide, about 19.17% is federal land, 47.53% is Indian land and 10.23% is state land. A graphic presentation of land ownership is given in Figure 1-2, (page 1-32). Basic land ownership and administration statistics are presented in Table 1-2, (page 1-33). Location is shown on the Land Ownership and Administration Map, following page 1-34.

Federal Land

Federal lands comprise 3,307,660 acres, or 19.17% of the land in the Basin. There are 2,459,390 acres (14.25%) in Arizona and 848,270 acres (4.92%) in New Mexico. Approximately 47.7% of the Basin land in Catron County, New Mexico and 27.8% of the Basin land in Coconino County, Arizona are federal lands (See Table 1-2).

Land in the federal system is administered by the Forest Service (FS) of the Department of Agriculture, by the Bureau of Land Management (BLM) and National Park Service (NPS) of the Department of the Interior, and by the Department of Defense.

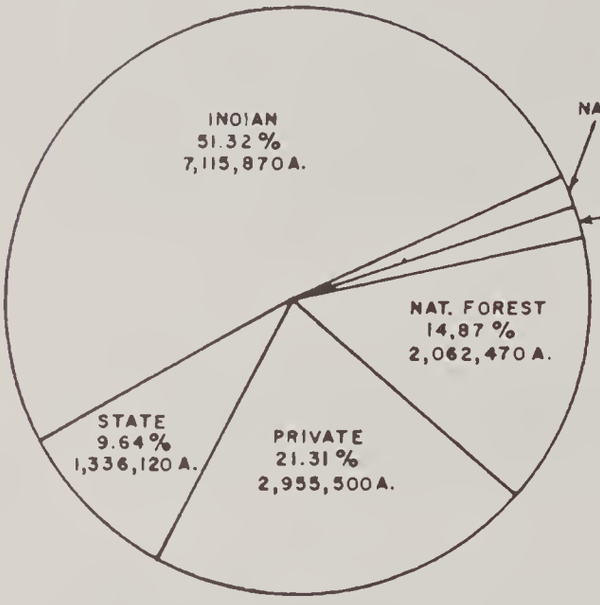
Forest Service: The Forest Service (FS) is the only land management agency within the Department of Agriculture. The FS administers about 2,366,710 acres (13.71%) of the Basin in four national forests: Kaibab (Arizona), Coconino (Arizona), Apache-Sitgreaves (Arizona and New Mexico) and Cibola (New Mexico). There are about 200,000 acres of private lands, 9,600 acres of state lands, and 5,290 acres of national monument lands within the national forest boundaries.

The majority of the lands within the national forests were reserved from the public domain under the authority of the 1897 Organic Act. The "forest reserves", as they were initially named, were established to improve and protect the forest lands, to secure favorable water flow conditions, and to furnish a continuous supply of timber for use by citizens of the United States.

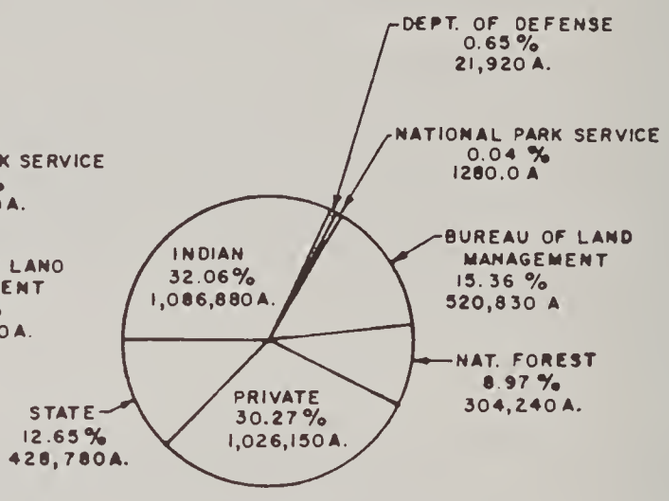
During the period 1898 to 1907, some forest lands were reserved by Executive Order. In 1907, Congress enacted a law that required an Act of Congress for further designation of national forest lands, and declared that existing "forest reserves" should thereafter, be referred to as "national forest".

LAND OWNERSHIP

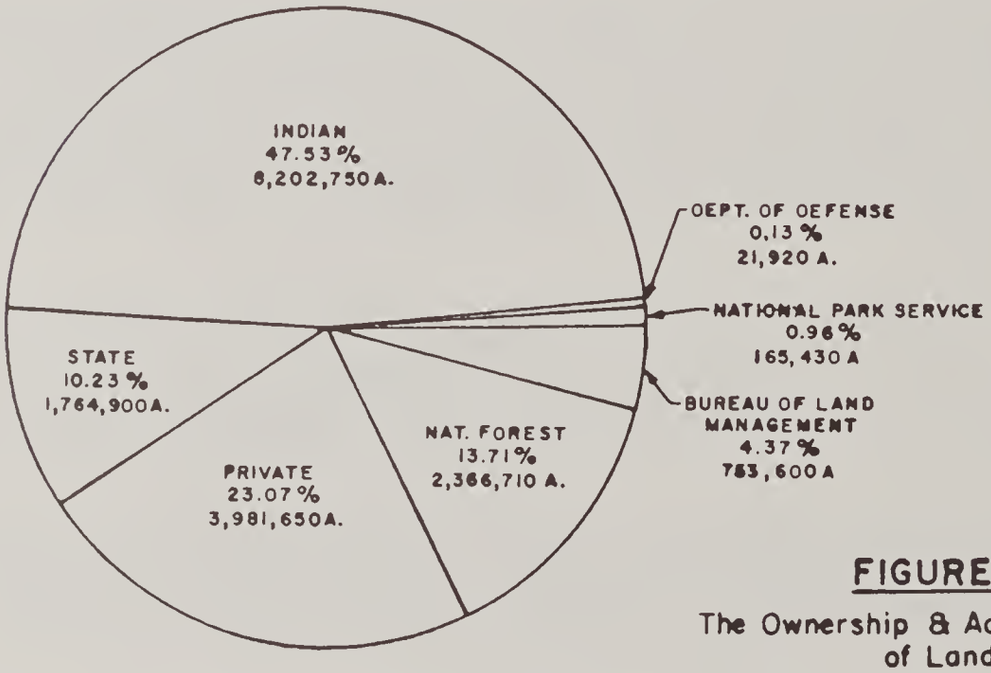
ARIZONA	-	13,866,880 Acres	80.35 %
NEW MEXICO	-	3,390,080 Acres	19.65 %
TOTAL	-	17,256,960 Acres	



ARIZONA



NEW MEXICO



TOTAL BASIN

FIGURE 1-2

The Ownership & Administration of Land
Little Colorado River Basin
in
Arizona and New Mexico
January 1979

TABLE 1-2: Land Ownership & Administration-1978
Little Colorado River Basin Arizona & New Mexico

Ownership & Administration	ARIZONA				NEW MEXICO					
	Apache	Navajo	Coconino	Total	San Juan	McKinley	Valencia	Catron	Total	Total Basin (Acres)
Federal Land										
Forest Service	288,950	471,760	1,301,760	2,062,470		77,060	29,560	197,620	304,240	2,366,710
% of County	7.36	9.48	26.22			5.81	3.26	17.22		
% of Basin	1.67	2.73	7.54	11.95		.44	.17	1.14	1.76	13.71
Bureau of Land Management	136,010	91,360	5,400	232,770		129,200	41,560	350,070	520,830	753,600
% of County	3.47	1.83	.11			9.74	4.59	30.51		
% of Basin	.79	.53	.03	1.35		.75	.24	2.03	3.02	4.37
National Park Service	69,290	23,200	71,660	164,150			1,280		1,280	165,430
% of County	1.76	.47	1.44				.14			
% of Basin	.40	.13	.42	.95			.01		.01	.96
Dept. of Defense						21,920			21,920	21,920
% of County						1.65				
% of Basin						.13			.13	.13
Total Federal	494,250	586,320	1,378,820	2,459,390		228,180	72,400	547,690	848,270	3,307,660
% of County	12.59	11.78	27.77			17.20	7.99	47.73		
% of Basin	2.86	3.40	7.99	14.25		1.32	.42	3.17	4.92	19.17
State										
State Trust	616,130	334,160	373,520	1,323,810		65,760	126,870	236,150	428,780	1,752,590
% of County	15.70	6.72	7.52			4.96	14.00	20.58		
% of Basin	3.57	1.94	2.16	7.67		.38	.74	1.37	2.48	10.16
Other State 1/	860	1,630	9,820	12,310						12,310
% of County	.02	.03	.20							
% of Basin	--	.01	.06	.07						.07
Total State	616,990	335,790	383,340	1,336,120		65,760	126,870	236,150	428,780	1,764,900
% of County	15.72	6.75	7.72			4.96	14.00	20.58		
% of Basin	3.57	1.95	2.22	7.74		.38	.74	1.37	2.48	10.23
Indian 2/	1,517,900	2,904,430	2,693,540	7,115,870	10,240	877,030	199,610		1,086,880	8,202,750
% of County	38.68	58.34	54.26	--	100.00	66.14	22.03			
% of Basin	8.80	16.83	15.61	41.24	.06	5.08	1.15		6.29	47.53
Private 3/	1,295,190	1,151,670	508,640	2,955,500		155,110	507,360	363,680	1,026,150	3,981,650
% of County	33.00	23.13	10.25			11.70	55.99	31.69		
% of Basin	7.50	6.67	2.95	17.12		.90	2.94	2.11	5.95	23.07
Total	3,924,330	4,978,210	4,964,340	13,866,880	10,240	1,326,080	906,240	1,147,520	3,390,080	17,256,960
% of State	28.30	35.90	35.80	100	.30	39.12	26.73	33.85	100	--
% of Basin	22.74	28.85	28.77	80.36	.06	7.68	5.25	6.65	19.64	100

1/ Does not include Highway R/W and other Lands Administered by State Dept's of Transportation
2/ Includes land Administered by Bureau of Indian Affairs
3/ Includes individually owned, corporate, county and municipal

The private lands within the national forests were acquired under various public land laws. These included the Homestead Act, the Timber and Stone Act, the Forest Homestead Act, and general mining laws.

The Forest Homestead Act of 1906 resulted in many open meadows and grasslands within the timberlands being patented for agricultural purposes. This occurred mainly between 1912 and 1925. Most of these lands proved to be poorly suited for agricultural purposes, especially dryland farming. This law has since been repealed.

At one time, the pattern of land ownership within the national forest lands between Heber and Flagstaff resembled a checkerboard. This resulted when alternate sections of land within 20 miles on each side of a railroad were granted to the railroad to aid in its westward expansion. In some areas grants up to 40 miles on each side of the railroad were made. This occurred near Indian reservations where alternate sections of land could not be granted. A high percentage of the granted railroad lands were reconveyed to the United States through the lieu selection process. The railroad selected an equal granted acreage of vacant public land in the western states in lieu of the granted acreage within the National Forest.

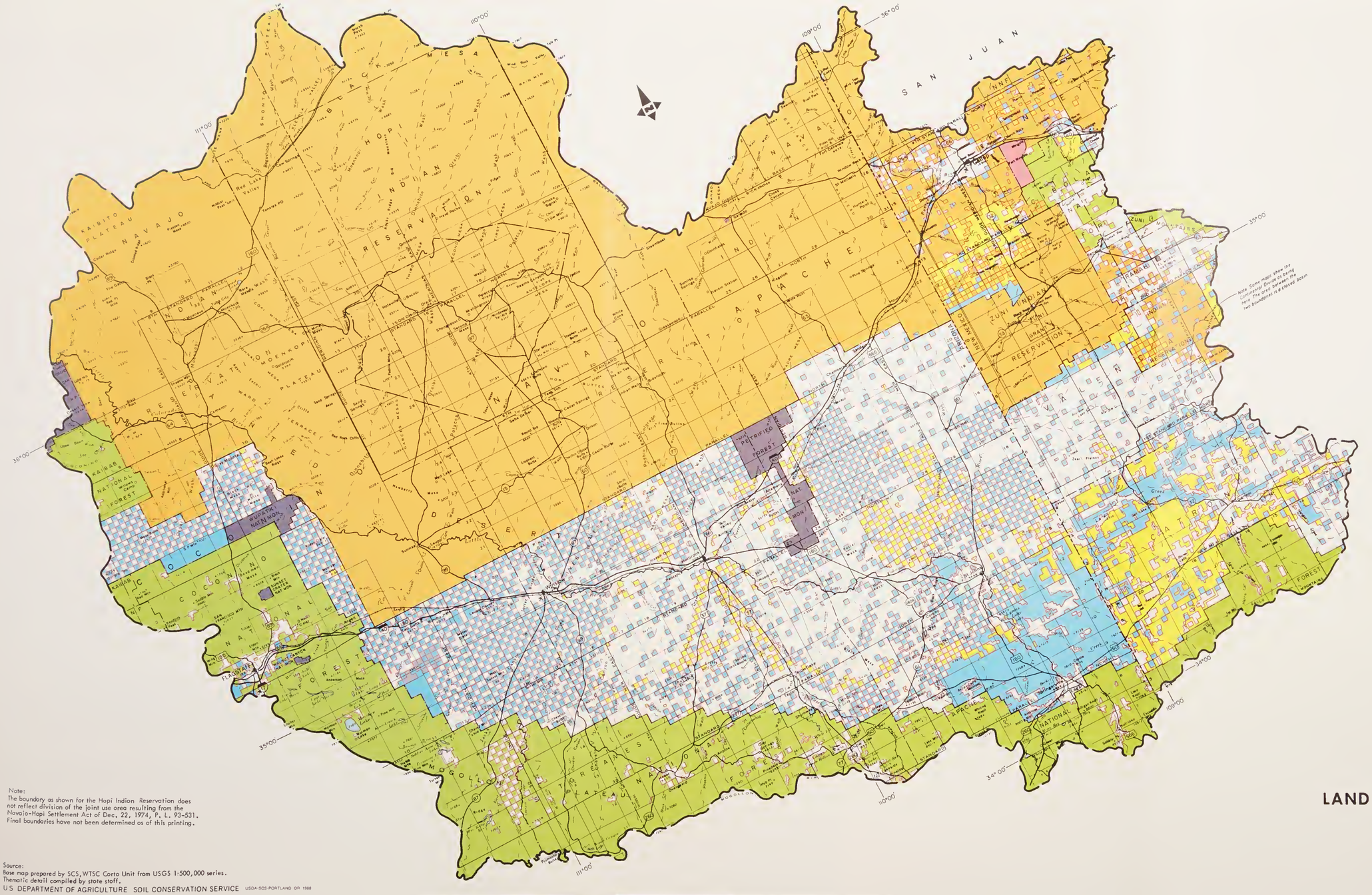
Around 1900 the Aztec Land and Cattle Company purchased many of the remaining railroad sections. In 1928 the Forest Service acquired these latter sections through a land exchange; but due to an error in the transaction, title to the lands reverted back to the Aztec Land and Cattle Company in 1955.

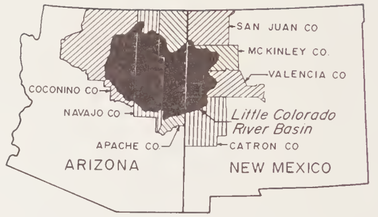
In the late 1950's the Southwest Forest Industries (SWFI) purchased the Aztec lands and mortgaged the timber on the lands to finance the construction of the Snowflake paper mill. During the 1960's and 1970's the Forest Service again acquired title to the majority of the Aztec lands through land exchanges with the SWFI. Although the FS obtained a fee title to the lands, the timber rights were retained by the SWFI. As a "base-for-exchange", the Forest Service traded lands in the Pinetop, Lakeside and Show Low areas. These were third party exchanges, involving land developers who received title to the national forest lands, and SWFI received payment from the developers.

The Forest Service's basic policy has been to exchange or purchase lands that will tend to consolidate or "block-in" national forest. This "blocking-in" helps to improve resource management, alleviate access problems, improve fire management, etc.

Most of the adjustments in national forest ownership have been made through exchanges. The principal act used for these exchanges has been the General Exchange Act of 1922. Provisions for purchasing land by the FS are contained in the 1956 USDA Organic Act and the 1965 Land and Water Conservation Fund Act. The Forest Service has no authority to sell land.

National forest lands adjacent to some communities are needed for orderly community development. Based on this need and public opinion, the FS has made some of these lands available for exchange. Such lands have been identified by the FS in a publication entitled, "Statewide Landownership Adjustment Plans for Arizona and New Mexico." This publication provides complete information, including maps, on the classification of lands designated as "base-for-exchange" and other lands desired to be acquired by the FS.





LOCATION MAP

LEGEND

- National Forest Service
- Bureau of Land Management
- National Park Service
- Department of Defense
- State Trust
- State Parks, Game & Fish Dept.
- Individual & Carporate
- Indian Lands

Note:
The boundary as shown for the Hopi Indion Reservation does not reflect division of the joint use area resulting from the Navajo-Hopi Settlement Act of Dec. 22, 1974, P. L. 93-531. Final boundaries have not been determined as of this printing.

Source:
Base map prepared by SCS, WTSC Corto Unit from USGS 1:500,000 series.
Thematic detail compiled by state staff.
U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE USDA-SCS-PORTLAND OR 1980

LAND OWNERSHIP AND ADMINISTRATION

LITTLE COLORADO RIVER BASIN

ARIZONA AND NEW MEXICO

1979

10 0 10 20 MILES

SCALE 1:1,000,000

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Bureau of Land Management: The Bureau of Land Management (BLM) is entrusted with the stewardship of public lands. Most of this land is what is left of the Nation's public domain. Public domain lands are defined as land that has never been in private ownership or withdrawn for specific purposes such as national parks, national forest, Indian reservations, defense installations, etc.

The BLM is committed to the principle that the remainder of the public domain lands shall be devoted to the best combination of uses in service of the Nation and the people, now and in the future. It has exclusive jurisdiction over about 753,600 acres (4.37%) the study area, including 232,770 acres (1.35%) in Arizona and 520,830 acres (3.02%) in New Mexico.

This land is scattered throughout the Basin. The largest blocks are in Catron County, New Mexico, of which 350,070 acres or 30.15% of the county are BLM lands. (See Table 1-2 and the Land Ownership and Administration Map).

The resource protection, management, and development activities of the BLM are conducted under a multiple use philosophy which attempts to maximize the total public and private benefits obtainable from the available financial and land resources. This policy of protection and management is summarized in the Federal Land Policy and Management Act of 1976. This Act calls for comprehensive land use planning. It provides broad management authority under principles of multiple use and sustained yield in accordance with land use plans. There are many other authorities and laws which govern the operation of the BLM in its management of the public domain.

Department of Defense:

The Fort Wingate Military Reservation located just east of Gallup, New Mexico is the only Department of Defense administered lands in the Basin. Fort Wingate is a U.S. Army ordinance depot, containing 21,920 acres, or 0.13% of the Basin.

National Park Service: The National Park Service administers 165,430 acres (0.96%) in the Basin, including 164,150 acres in Arizona and 1280 acres in New Mexico. This land is located in two national parks, five national monuments and one national historic site (See Table 1-3). All are in Arizona except the El Morro National Monument. The Hubbell Trading Post, the Petrified Forest National Park and the Sunset Crater, Wupatki, Walnut Canyon, and El Morro National Monuments are entirely within the Little Colorado River Basin. The Basin's north boundary bisects the Navajo National Monument, and only a small part of the Grand Canyon National Park is within the Basin.

Private Lands

About 3,981,650 acres or 23.07% of the Basin is in private ownership. This includes 2,955,500 acres in Arizona and 1,026,150 acres in New Mexico. Valencia County, New Mexico, with 507,360 acres, has the highest percentage (55.99%) of its land in private ownership. The lowest is Coconino County, Arizona, with 508,640 acres or 10.25%. (See Table 1-2.)

Most of these lands were obtained from the public domain under various land laws. In the early 1850's, railroad land grants were given to encourage and

Table 1-3

Land Administered by The National Park Service

Little Colorado River Basin, Arizona and New Mexico

ARIZONA	Year Proclaimed	Area within Basin (Acres)
Hubbell Trading Post National Historic Site	1965	160
Petrified Forest National Park	1906 1/	93,490
Navajo (Betatakin) National Monument	1909	160
Sunset Crater National Monument	1930	3,040
Wupatki National Monument	1924	35,250
Walnut Canyon National Monument	1915	2,250
Grand Canyon National Park	1908	29,800
		164,150
NEW MEXICO		
El Morro National Monument	1906	1,280

1/ Wilderness designation for 50,260 acres in 1970.

assist the building of railroads in the sparsely settled sections of the country. The Santa Fe Railroad received government grants for alternate sections of land in strips approximately 20 miles wide (and in some case 40 miles wide) on each side of the railroad. The railroads sold this land to individuals, corporations, municipalities, etc. to finance the construction of the railroads. Public domain lands were also transferred to private ownership through various homestead acts.

County and Municipal

There are small amounts of land within the Basin that are owned and administered by cities, towns, and counties. No attempt has been made to show the location or tabulate individual acreages for these lands. They are included with Private Lands.

Indian Lands

Indian lands total about 8,202,750 acres or 47.53% of the Basin. Included in this total are Indian trust lands, tribally-owned fee title lands, Bureau of Indian Affairs federally-owned lands, and individually-owned Indian trust allotments. No attempt was made to separate these lands by type of administration. Table 1-2, however, does show the distribution of these lands by county and state, and Table 1-4 gives the distribution by Indian reservation.

There are five Indian reservations located entirely or partly within the Little Colorado River Basin: the Fort Apache Indian Reservation (Arizona), the Hopi Indian Reservation (Arizona), the Navajo Indian Reservation, i.e. the Navajo Nation (Arizona and New Mexico), the Zuni Indian Reservation (New Mexico) and the Ramah or Ramah-Navajo Indian Reservation (New Mexico).

The Fort Apache Indian Reservation (White Mountain Apache Tribe) has about 1,900 acres within the Basin. This land is in the White Mountains along the Basin's southern boundary. There are about 1,600 acres in Apache County near Mount Baldy and 300 acres in Navajo County.

The Hopi Indian Reservation is located within the boundaries of the Navajo Indian Reservation. The Navajo Indian Reservation was established by treaty in 1868. The boundary was modified by several Executive Orders up until the early 1900's. In 1882, an Executive Order set aside about 2,500,000 acres for the Hopi (Moquis) Indians and "other Indians as the Secretary of Interior may see fit to settle thereon." This land is referred to as the "1882 Executive Order Reservation", and is shown on many maps as a rectangular-shaped "Joint Use Area" between latitudes 35^{o} 31' and 36^{o} 30'; and longitudes 110^{o} and 111^{o}.

In 1934, the Navajo Boundary Act consolidated the boundaries from previous treaties and Executive Orders and put a boundary on the Navajo Reservation in Arizona. The area within the 1882 Executive order Reservation was excepted.

In 1958, Congress authorized a three-judge U.S. District Court to adjudicate the conflicting claims of the tribes to the 1882 Reservation. In 1962, the case of Healing vs. Jones (the "Healing Case") established the 1943 land management boundary (Grazing District 6) within the 1882 Reservation as exclusively Hopi. This District 6 is shown on some maps in the form of a "shield" running diagonally across the 1882 Reservation. This District in recent years has been referred to as the Hopi Indian Reservation, and consist of 650,013 acres. The "Healing Case" also established the remainder of the 1882 Reservation (1,822,082 acres) as jointly owned by the Navajo and Hopi tribes.

In 1974, the Navajo-Hopi Settlement Act (Public Law 93-531, dated December 22, 1974) was passed to provide for final settlement of conflicting rights and interests between the Navajo and Hopi tribes to the lands lying within the "Joint Use Area" and outside of District 6. This act divided the surface rights to the remaining area equally, in size and quality, between the two disputing tribes. This act (Sec. 11) also authorized the transfer of up to 250,000 acres of lands under the jurisdiction of the Bureau of Land Management within the State of Arizona or New Mexico to the Navajo Tribe, provided that the Tribe pay to the United States the fair market value for such lands. This land was intended for the relocation of Navajo families from the Joint Use Area. The land that was selected for transfer was on the Paria Plateau in Arizona, just north of the Colorado River, and not within the Little Colorado River Basin. In 1980, the act was amended by Public Law 96-305 (July 8, 1980) whereas the Navajo Tribe now attains up to 250,000 acres of public land free with the option to buy another 150,000 acres. This land cannot be north or west of the Colorado River nor can more than 35,000 acres be in New Mexico. Further, the land must be within 18 miles of the 1934 Reservation Boundary.

As of this writing, the selection of this land has not been made. There is strong possibility that the land will be within the Little Colorado River Basin, although there is not enough public land (see Land Ownership Map) within an 18 mile distance of the reservation boundary to meet all of the criteria contained in P.L. 96-305. An option is to exchange public land

elsewhere in the State of Arizona for private lands contiguous to the Reservation, then transfer the public land to the Navajo's.

It is difficult to accurately assess the final outcome of the Navajo-Hopi Settlement Act. The total acreage figures in Table 1-4, however, shows an equal division of the remaining "Joint Use Area" but no provisions have been made for the additional 400,000 acres which might become a part of the Navajo Reservation. For example, the Hopi Reservation shows a total area 1,561,254 acres. This total includes District 6 (650,013 acres), one-half of the remaining "Joint Use Area" (911,041 acres) plus 200 acres of off-reservation land near Winslow, Arizona. This latter area is Indian trust land at an industrial park of which 120 acres are in Navajo County and 80 acres are in Coconino County. The Hopi acreage does not include a Hopi Village at Moenkopi in Coconino County.

The total acreages in Table 1-4 for the Navajo Reservation include the other half of the "Joint Use Area". It does not show; however, the several thousand acres of private ranch land adjoining the Navajo Reservation near Chambers, Arizona which have been purchased by the Navajo Tribe. This land is shown in Table 1-2 and on the Land Ownership and Administration Map as private land.

The Zuni Indian Reservation was established by Executive Order in 1877, and expanded by Executive Order in 1917 and by Congressional Act in 1935. The original reservation contained about 239,945 acres. It included the original Zuni Pueblo Land Grant made in 1689. The Land Grant contains about 17,636 acres, and was confirmed in 1931 and patented in 1933. The total area in the present reservation is about 408,390 acres (Table 1-4).

The Ramah-Navajo Indian Reservation, located in New Mexico on the east side of the Little Colorado River Basin, contains about 120,980 acres of Indian lands. These include trust lands with title in the main Navajo Tribe, trust lands with title in the Ramah Band of Navajo Indians, individually owned trust allotments, and government lands administered by the Bureau of Indian Affairs.

State of Arizona

Arizona attained statehood in 1912 and was granted four sections of land per township for aid to education, with the title to pass when the lands were surveyed. Arizona also secured additional lands to support penitentiaries, military institutions, and for similar purposes.

Arizona State Trust Lands: The majority of the state land in the Arizona part of the Little Colorado River Basin are State Trust Lands administered by the Arizona State Land Department. The State Land Commissioner, as executive officer of the Land Department, interprets and administers all laws pertaining to these lands.

There are 1,323,810 acres of Arizona State Trust Lands within the Basin. These are generally scattered in a checkerboard pattern except for large contiguous blocks north of Springerville, Arizona (See Land Ownership and Administration Map).

Table 1-4

Land Ownership and Administration

Indian Lands

Little Colorado River Basin

Arizona and New Mexico

January 1979

(Acres)

ARIZONA[1/]	County			Total
	Apache	Navajo	Coconino	
Indian Reservations:				
Fort Apache	1,600	300	--	1,900
Navajo	1,516,300	1,835,906	2,200,510	5,552,716
Hopi	--	1,068,224	493,030	1,561,254
	1,517,900	2,904,430	2,693,540	7,115,870

NEW MEXICO	San Juan	McKinley	Valencia	Total
Indian Reservations:				
Navajo	10,240	547,270	--	557,510
Zuni	--	323,430	84,960	408,390
Ramah-Navajo	--	6,330	114,650	120,980
	10,240	877,030	199,610	1,086,880

1/ Acreages shown for the Navajo and Hopi Reservations in Navajo and Coconino counties are approximate values expected to result from partition of the Joint Use Area from the Navajo-Hopi Settlement Act of December 22, 1974, Public Law 93-531.

State trust land can pass into private ownership either by outright sale or by exchange. In March 1978, the State Land Department sold 13,362 acres in Apache County at auction to the Tucson Electric Power Company. This land will be used as a well field for a proposed power plant. The land is to revert back to the State of Arizona at the conclusion of the life of the power plant, and the State is to receive $5.00 per acre-foot for water withdrawn from these lands.

Arizona - Other State Lands: Small parcels of state land are administered by the Arizona Department of Transportation (highway rights-of-way, maintenance yards, etc.), the State Game and Fish Department, the State Parks Board, and Northern Arizona University at Flagstaff.

There are about 12,310 acres of Other State Land within the Little Colorado River Basin (Table 1-2). Those administered by the Arizona Game and Fish Department are shown in Table 1-5. The State Parks Board administers about 80 acres at Lyman Lake in Apache County. No attempt has been made to show the amount of land administered by the Arizona Department of Transportation and the University.

State of New Mexico

New Mexico attained Statehood in 1912, and like Arizona, was granted four sections per township from the public domain.

New Mexico state lands are administered by the Commissioner of Public Lands with assistance from other state agencies. The agencies include the State Park Commission, the State Forestry Commission, the State Department of Game and Fish, the State Engineer (for use of water from state lands), the State Department of Transportation and others.

There are about 428,780 acres of New Mexico State Trust Land in the Basin (Table 1-2). Those administered by the New Mexico Game and Fish Department are shown in Table 1-5. No attempt has been made to show the land utilized by the highway system or similar purposes.

LAND COVER AND MANAGEMENT

Cover conditions vary from dense forest (Photo 1-9, page 1-42) to nearly barren desert areas (Photo 1-10, page 1-42). This variation is further illustrated on the Vegetation Communities Map located following page 1-42; and acreages of the vegetation communities are given in Table 1-6, page 1-43. The vegetal cover variation is related to such factors as elevation, exposure and effective climate.

Management of the plant cover is of particular importance in this Basin because of the limited regrowth possibilities imposed by the lack of precipitation and other climatic factors. Sediment production is directly related to the kind and amount of plant cover. Most of the higher sediment producing areas are the more arid, poorly vegetated soils. The irrigated croplands and dry cultivated lands contribute to the sediment production. The principal erosive areas, however, are the semiarid rangelands and badlands areas.

Table 1-5

Lands Administered by

Arizona and New Mexico Game and Fish Departments

Little Colorado River Basin, Arizona and New Mexico[1/]

ARIZONA

Apache County	Acres
Becker lake	337.8
Nelson Lake Tract	160.0
Lee Valley Tract	71.0
Concho Lake	209.0
	777.8
Navajo County	
Silver Springs	821.0
Rainbow Lake	3.0
Pinetop Regional Office	45.0
Chevelon Wildlife	668.0
Fools Hollow Lake	96.1
	1,633.1
Coconino County	
Veit Ranch	160.0
Flagstaff Regional Office	60.0
Vincent Ranch	36.0
Chevelon Canyon Ranch	121.0
Raymond Ranch	9,438.0
	9,815.0
Total Arizona	12,225.9

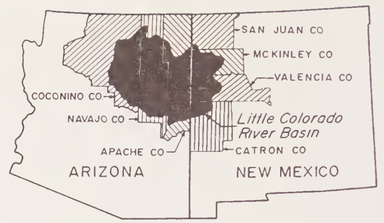
NEW MEXICO

Catron County	
Quemado Lake	130
McKinley County	
McGaffey Lake	14
Total New Mexico	144

1/ Does not include leased land

Photo 1-9: A view of the dense forest vegetative cover which is typical in the southern part of the Basin along the Mogollon Rim.

Photo 1-10: Grand Falls on the Little Colorado River. Note the near barren desert conditions surrounding the Falls.



LOCATION MAP

LEGEND

- Alpine Tundra
- Spruce-Alpine Fir Forest
- Mantane Canifer Forest
- Juniper-Pinyan Woodland
- Plains and Desert Grassland
- Mountain Meadow Grassland
- Great Basin Desert Scrub

15020004 Hydrologic Unit Code
US Water Resource Council

NOTE: Description of vegetation communities are in the Fish and Wildlife Section of the report.

Note: Some maps show the Continental Divide as the here. The area between the two boundaries is a closed basin

Note:
The boundary as shown for the Hopi Indian Reservation does not reflect division of the joint use area resulting from the Navajo - Hopi Settlement Act of Dec. 22, 1974, P.L. 93-531 Final boundaries have not been determined as of this printing.

Source:
Base map prepared by SCS, WTSC Carto Unit from USGS 1:500,000 series.

Biotic Communities of the Southwest, by David E. Brown and Charles H. Lowe. Map published in 1978 through Rocky Mountian Forest and Range Experiment Station, USDA Forest Service. General Technical Report RM-41

Several amendments to the Brown and Lowe map were made based on information from:
Arizona Land Marks, Volume 7, Book 5, 1977, Arizona State Land Department.
Forest Type Map of Navajo Nation, Bureau of Indian Affairs, Window Rock, Arizona.

VEGETATION COMMUNITIES
LITTLE COLORADO RIVER BASIN
ARIZONA AND NEW MEXICO

1980

10 0 10 20 MILES
SCALE 1:1,000,000

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE USDA-SCS-PORTLAND OR 1980

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Table 1-6

Acreages of Vegetation Communities

Little Colorado River Basin

Arizona and New Mexico

(Acres)

Vegetation Community	Arizona	New Mexico	Total
Alpine tundra	1,500	--	1,500
Spruce-alpine fir forest	28,300	--	28,300
Montane conifer forest	1,188,760	229,660	1,418,420
Juniper-pinon woodland	2,671,580	2,606,160	5,277,740
Plains and desert grassland	7,034,340	450,230	7,484,570
Mountain meadow grassland	16,200	--	16,200
Great basin desert scrub	2,714,530	67,980	2,782,510
Other[1/]	211,670	36,050	247,720
	13,866,880	3,390,080	17,256,960

1/ Includes cultivated land, urban land, remote subdivisions and water acreages as presented in Tables 1-8, 1-9 and 1-10.

Some of the lands within the Basin are managed as wilderness areas. There are two such designated areas in the Basin. These are the Mount Baldy Wilderness, located 20 miles southwest of Springerville, and the Petrified National Forest Wilderness, located about 25 miles east and northeast of Holbrook.

The Mount Baldy Wilderness contains about 7,709 acres on the eastern slope of Mount Baldy and lies entirely within the Apache-Sitgreaves National Forest. The peak itself is on the Fort Apache Indian Reservation. Elevations range from 9,000 to 11,403 feet above sea level.

The Petrified Forest Wilderness contains about 50,260 acres, all within the boundaries of the Petrified Forest National Park.

RARE II is a comprehensive process, instituted in June 1977 by the Forest Service, to identify roadless and undeveloped land areas in the National Forest system, and to determine their general uses for both wilderness and other resource management and development. The RARE II process identified 13 roadless areas encompassing 78,330 net acres within the Little Colorado River Basin. The process led to recommendations for allocations of each of these areas to wilderness, nonwilderness, or as needing further planning for all uses, including wilderness. Table 1-7 lists the review areas, and the recommended allocation. Congressional action is required for classification of an area as wilderness.

LAND USE

Major agricultural uses of land in the Basin are, grazing, forestry and farming. (See Land Cover and Management Section of this report.) Their relationships are shown in Tables 1-8, 1-9 and 1-10 by major cover types.

Irrigated cropland (Photo 1-11, page 1-49) occupies less than 0.2 percent of the land area, but is an important asset to farmers and ranchers. Most of the irrigated acreage is used to raise feed which supplements the forage supplied by the range. In portions of the Basin, irrigated lands are depended upon to furnish forage during the spring and fall when the livestock are not on the range.

Dry cropland (Photo 1-12, page 1-49) is used largely for small grain production. There is a recent trend of converting the poorer cropland to grass. Grazing by far is the major land use within the Basin. Both Juniper-Pinon Woodland (Photo 1-13, page 1-50) and Plains and Desert Grasslands (Photo 1-14, page 1-50) are used for this purpose, as well as most other major vegetation communities within the Basin.

Recreation is a major use of land in the Basin and is generally compatible with other resource uses. Surface water areas (Photo 15, page 1-51) have increasingly heavy recreation uses for boating, fishing and general vacationing.

Mining, transportation, utilities and urban areas occupy a small percent of the land area for high value purposes. Some of the land is being developed as remote subdivisions. (See Remote Subdivision Map, following page 1-52.)

Table 1-7

Roadless Areas Reviewed and Evaluated within the

Little Colorado River Basin,

Arizona and New Mexico

ARIZONA

National Forest	Area Name	Allocation*	Gross Acres	Net Acres
Apache	Escudilla Mountain	NW	3200	3200
Coconino	Jacks Canyon	NW	5010	5010
Coconino	East Clear Creek	NW	1730	1400
Coconino	Barbershop Canyon	NW	1290	1290
Coconino	Lower Jacks Canyon	FP	870	870
Coconino	Strawberry Crater Canyon	FP	8050	8050
Coconino	San Francisco Peaks	W	17980	17940
Coconino	Kendrick Mountain	W	2200	2200
Coconino	Padre Canyon	NW	9910	9910
Coconino	Strawberry Crater North	FP	1790	1790
	Total Arizona		52,030	51,660

NEW MEXICO

National Forest	Area Name	Allocation*	Gross Acres	Net Acres
Gila	The Hub	NW	7770	7770
Gila	Brushy Springs	NW	5790	5790
Gila	Largo	NW	13110	13110
	Total New Mexico		26,670	26,670
	Total Basin		78,700	78,330

*The Forest Service's recommendation (W) wilderness, (NW) nonwilderness, (FP) further planning.

Table 1-8: Land Areas by Cover Types and Related Categories, Little Colorado River Basin, Arizona

Cover Types and Related Categories	Private	National Forest	National Park Service	Indian Lands 1/	Bureau of Land Management	Dept. of Army	State and Local Government	Total Arizona
	Acres							
Alpine Tundra	0	1,500	0	0	0	0	0	1,500
Forest								
Coniferous forest	45,520	965,700	4,000	196,720	0	0	5,120	1,217,060
Pinyon-Juniper Woodland	241,130	813,910	23,000	1,386,330	67,000	0	140,210	2,671,580
Range								
Plains desert grassland	2,264,670	266,060	122,750	3,285,590	50,570	0	1,044,700	7,034,340
Great basin desert scrub	194,950	0	14,400	2,244,490	115,200	0	145,490	2,714,530
Mountain meadow grassland	3,800	12,400	0	0	0	0	0	16,200
Cultivated								
Irrigated	29,430	0	0	440	0	0	2/	29,870
Dryland	4/	0	0	4/	0	0	0	4/
Urban	12,000	0	0	2,000	0	0	0	14,000
Remote Subdivisions	163,200	0	0	0	0	0	0	163,200
Water 3/	800	2,900	0	300	0	0	600	4,600
Total	2,955,500	2,062,470	164,150	7,115,870	232,770	0	1,336,120	13,866,880

1/ Includes federal, private, and trust lands (Indian lands).

2/ Unknown amount - included with private acres.

3/ Includes water surfaces having 40 acres or more of area and streams of 1/8-mile or more in width.

4/ Only minor acreage of dryland farming exists in the Arizona portion of the Basin, mostly on Indian Reservations. Actual acreage not determined.

Source: Modified from the Lower Colorado Region Comprehensive Framework Study, Appendix VI.

Table 1-9: Land Areas by Cover Types and Related Categories, Little Colorado River Basin, New Mexico

Cover Types and Related Categories	Private	National Forest	National Park Service	Indian Lands 1/	Bureau of Land Management	Dept. of Defense	State and Local Government	New Mexico
	Acres							
Alpine Tundra	0	0	0	0	0	0	0	0
Forest								
Coniferous forest	20,500	152,800	0	46,180	0	8,980	1,200	229,660
Pinyon-Juniper Woodland	880,990	143,360	0	899,240	321,200	11,940	349,430	2,606,160
Range								
Plains desert grassland	92,380	7,980	1,280	76,280	196,400	0	75,910	450,230
Great basin desert scrub	2,730	0	0	58,780	3,230	1,000	2,240	67,980
Mountain meadow grassland	0	0	0	0	0	0	0	0
Cultivated								
Irrigated	1,550	0	0	3,400 3/	0	0	0	4,950
Dryland	4,200	0	0	0	0	0	0	4,200
Urban	7,000	0	0	2,000	0	0	0	9,000
Remote Subdivisions	16,800	0	0	0	0	0	0	16,800
Water 2/	0	100	0	1,000	0	0	0	1,100
Total	1,026,150	304,240	1,280	1,086,880	520,830	21,920	428,780	3,390,080

1/ Includes federal, private, and trust lands (Indian lands).

2/ Includes water surfaces having 40 acres or more of area and streams of 1/8-mile or more in width.

3/ Note, there are approximately 8200 acres of land under ditch on Indian Reservations which could be irrigated if waters were available.

Source: Modified from the Lower Colorado Region Comprehensive Framework Study, Appendix VI.

Table 1-10: Summary of Land Areas by Cover types and Related Categories, Little Colorado River Basin, Arizona and New Mexico

Cover Types and Related Categories	Private	National Forest	National Park Service	Indian Lands 1/	Bureau of Land Management	Dept. of Defense	State and Local Government	Total
	Acres							
Alpine Tundra	0	1,500	0	0	0	0	0	1,500
Forest								
Coniferous forest	66,020	1,118,500	4,000	242,900	0	8,980	6,320	1,446,720
Pinyon-Juniper Woodland	1,122,120	957,270	23,000	2,285,570	388,200	11,940	489,640	5,277,740
Range								
Plains desert grassland	2,357,050	274,040	124,030	3,361,870	246,970	0	1,120,610	7,484,570
Great basin desert scrub	197,680	0	14,400	2,303,270	118,430	1,000	147,730	2,782,510
Mountain meadow grassland	3,800	12,400	0	0	0	0	0	16,200
Cultivated								
Irrigated	30,980	0	0	3,840	0	0	2/	34,820
Dryland	4,200	0	0	0	0	0	0	4,200
Urban	19,000	0	0	4,000	0	0	0	23,000
Remote Subdivisions	180,000	0	0	0	0	0	0	180,000
Water 3/	800	3,000	0	1,300	0	0	600	5,700
Total	3,981,650	2,366,710	165,430	8,202,750	753,600	21,920	1,764,900	17,256,960

1/ Includes Federal, private and trust lands (Indian lands).

2/ Unknown amount - included with private acres.

3/ Includes water surfaces having 40 acres or more of area and streams of 1/8-mile or more in width.

Source: Modified from the Lower Colorado Region Comprehensive Framework Study, Appendix VI.

Photo 1-11: Irrigated cropland located along the Little Colorado River.

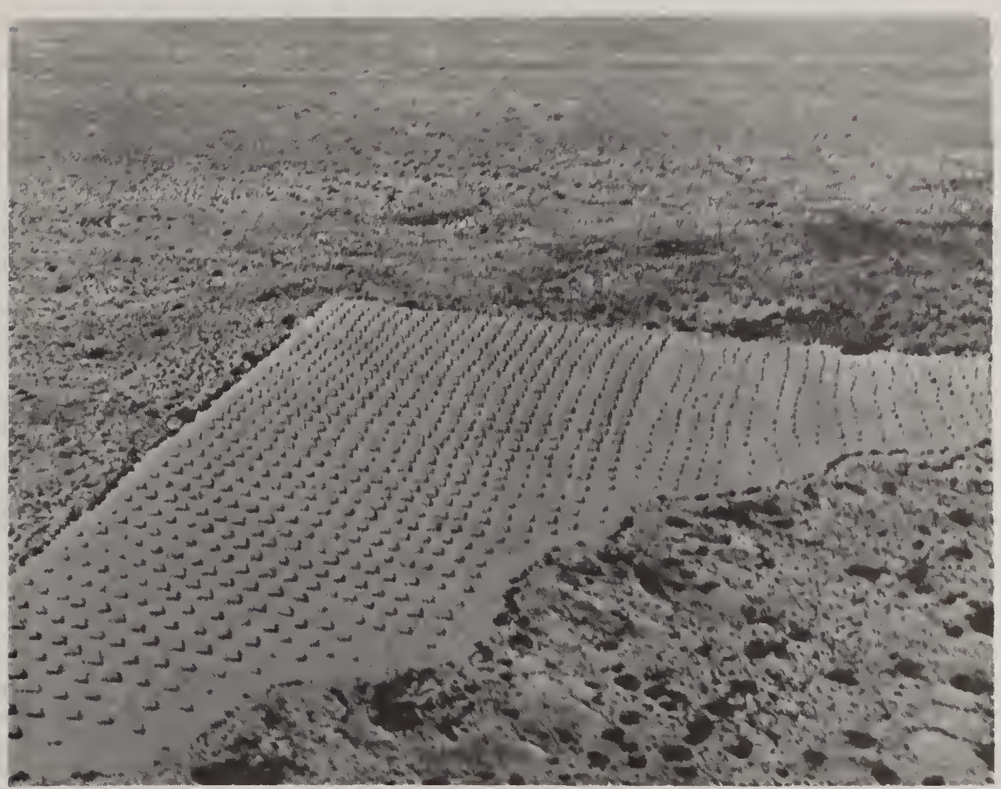

Photo 1-12: Dryland farming located along Polacca Wash on the Hopi Indian Reservation.

Photo 1-13: Juniper-pinon and grasslands located northeast of Show Low, Arizona.

Photo 1-14: Typical view of plains and desert grassland area located between Springerville and St. Johns, Arizona.

Photo 1-15: An aerial view of the Nelson Reservoir located southeast of Springerville, Arizona.

PRIME FARMLAND[1/]

Prime farmland, either dryland or irrigated, may be regarded as that land composed of soils that have the best combination of physical and chemical characteristics for producing food, fiber, forage, feed, and oilseed crops; and is readily available for that use. Such land has the soil quality, growing season, and necessary moisture available to economically produce a sustained high yield of crops when treated and managed properly.

In general, prime farmlands have acceptable levels of alkalinity or acidity, salt and sodium content, and few or no rocks. They are permeable to water and air and are neither excessively erodible nor saturated with water for long periods. They seldom flood, or are protected from flooding. Prime farmlands have an adequate, dependable moisture supply from precipitation or from irrigation water sources.

1/ Prime Farmlands are designated by the USDA Soil Conservation Service under authority of Public Law 92-419, Section 302, Title 3 of the Rural Development Act of 1972. The authority was further clarified by a joint memorandum from the Director of the Council of Environmental Quality and the Secretary of Agriculture, dated August 30, 1976.

Besides having to be readily available, prime farmlands must meet the following criteria:

1. There must be a developed irrigation water supply that is dependable. (In general, supplies are considered dependable if available at least 8 out of 10 years and are of adequate quality.)[1/]

2. The available water capacity of the soil must be at least four inches of water within a depth of 40 inches of soil profile.

3. The mean annual soil temperature regime must exceed 32° F.

4. Soil pH must range between 4.5 and 8.4 within a depth of 40 inches or within the root zone for shallow rooted crops.

5. The soil must either have no water table or it must be maintained at a depth where it will not adversely affect crop growth during the cropping season.

6. Soil salinity or alkalinity must not adversely affect crop growth.

7. The soil must not be subject to flooding more often than once in two years during the cropping season.

8. The soil must not have a serious erosion hazard.

9. The soil permeability must be at least 0.06 inch per hour in the upper 20 inches.

10. The surface layer must consist of less than 10 percent rock fragments coarser than 3 inches, and the soil should present no particular difficulties when cultivated with large equipment.

Dryland farming in the Basin is relatively unimportant, consisting of about 4,200 acres in New Mexico none of which qualify as prime farmland. Soil surveys of the Arizona portion of the Basin indicate approximately 2,800 acres of prime dryland but none is farmed other than gardens, small scattered pastures, and parcels of feed grains.

This contrasting lack of interest in dryland farming in Arizona is most likely due to a number of reasons, the chief of which are:

1. Sporadic summer rains of unpredictable distribution and frequency.

2. Uneven rainfall years and/or seasons that, albeit average adequacy, are deficient or overabundant during crucial periods of the cropping season.

1/ This criterion applies to irrigated prime farmland. Prime dryland requires an average annual precipitation of 18" or better, and the precipitation must be distributed at a proper frequency to supply adequate water to the crop.

LOCATION MAP

• Each Dot Represents a Section of Land in Which One or More Subdivisions Have Been Recorded Prior to 1978.

REMOTE SUBDIVISIONS

LITTLE COLORADO RIVER BASIN

ARIZONA AND NEW MEXICO

JANUARY 1980

10 0 10 20 30 40 MILES

SCALE 1:2,000,000

Source:
Base map prepared by SCS, WTSC Carto Unit from USGS 1:500,000 series.
Thematic detail compiled by state staff from
Arizona Office of Economic Planning and Development
New Mexico County Records.

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3. Short growing seasons at elevations that receive favorable amounts of rainfall at proper intervals.

4. Land ownership and use patterns that preclude farming other than small parcels of land.

Irrigated agriculture in the Basin is not nearly so reliant on rainfall distribution and frequency as is dryland agriculture. Storage of spring snowmelt is the primary source of water for the majority of the Basin's irrigated cropland. Other sources include catchment of storm runoff, live streams, and groundwater. The latter is used throughout the Basin to supplement surface water or, in several cases, as the primary source. Times of drought may affect the dependability of the storage systems but, in general, supplies are considered adequate in at least 8 out of 10 years.

Not all of the irrigated land in the Basin meets the prime farmland criteria. Of the approximately 34,820 acres of irrigated land in the Basin, about 10,600 acres in Arizona and 2,100 acres in New Mexico are considered prime. Prime irrigated acreage breakdown by water use area (WUA) and locale is shown in Table 1-11. (Also, see the Generalized Irrigated Areas Map, following page 1-54).

The fact that prime farmland is one of the Nation's most important resources lies in its capacity to be farmed continuously or nearly continuously without degrading the environment. It produces food, fiber, and feed crops with the least amount of energy used and responds exceptionally well to fertilizer application, inherently resisting leaching and erosion loss of fertilizer or other chemical residues. Prime farmland is also the most responsive to management and requires the least investment for maintaining productivity.

USDA recognizes that the attributes of prime farmland cause it to be a most likely candidate for urban and suburban development. While specific land use designation is a prerogative of state and local officials, USDA is nonetheless concerned about the loss of such a valuable resource to non-agricultural uses. Three example areas in the Basin are Snowflake-Taylor, St. Johns-Lyman, and Springerville-Eager. These three areas comprise about 56% of the prime farmland in the Basin. They are projected to increase in non-agricultural population; causing increasing pressure for the urbanization of the prime farmland. The St. Johns-Lyman area is expected to receive the greatest urbanizing pressure. About 14% of the Basin's prime farmland occurs in this area.

The remaining irrigated land in the Basin, i.e., non-prime, is still considered to be important farmland because of its contribution to the economy and interests of Basin residents. Generally, the soils comprising these lands exhibit such flaws as seasonal wetness, droughtiness, slow permeability rate, moderate amounts of soluble salts, or undependable water supply. Even so, these soils are nonetheless productive when managed carefully and cropped with adapted crops.

PRIME FORESTLANDS

The USDA, Secretary's of Agriculture Memorandum Number 1827, revised October 30, 1978, lists definitions and criteria for prime timberland, unique timberland, and timberland of statewide and local importance.

Table 1-11

Prime Irrigated Farmland Little Colorado River

Basin, Arizona and New Mexico

ARIZONA

White Mountains WUA	
Show Low	480 acres
Lakeside Area	55 acres
Lakeside Town	50 acres
Pinetop-Woodland	85 acres
Springerville-Eagar	3,000 acres
Nutrioso	900 acres
Concho WUA	
Concho	10 acres
Hunt	575 acres
St. Johns WUA	
St. Johns-Lyman	1,920 acres
Holbrook WUA	
Holbrook	75 acres
Hay Hollow	375 acres
Woodruff	95 acres
Snowflake WUA	
Snowflake-Taylor	2,990 acres
Total Arizona	10,610 acres

NEW MEXICO

Zuni WUA	
Nutria	200 acres
Pescado	215 acres
Tekapo	90 acres
Zuni	660 acres
Ojo Caliente	235 acres
Ramah	550 acres
Nicoll's Lake	100 acres
Carrizo Wash WUA	
Mangas Springs	50 acres
Total New Mexico	2,100 acres

LOCATION MAP

LEGEND

IRRIGATED AREAS

MORTON

WATER USE AREAS

ARIZONA

BLM	Block Mesa Area
BOD	Bodaway Mesa Area
CDI	Conyon Diablo Area
CHV	Chevelon Area
CHN	Chinle Valley Area
CON	Concha Area
HOL	Holbrook Area
HOP	Hopi Area
KAI	Kaibito Plateau Area
PRZ	Puerco - Zuni Area
STJ	St. Johns Area
SFP	San Froncisco Peoks Area
SNO	Snowflake Area
TUB	Tuba City Area
WHM	White Mountain Area

NEW MEXICO

CAR	Corrizo Wash Area
UPR	Upper Puerco Area
ZUN	Zuni Areo

NOTE:
In Arizona, Water Use Areas ore Ground Water Study Areos; in Mew Mexico they represent Hydrologic Boundaries.

IRRIGATED AREAS

LITTLE COLORADO RIVER BASIN

ARIZONA AND NEW MEXICO

JANUARY 1980

10 0 10 20 30 40 MILES

SCALE 1:2,000,000

Source:
Base map prepared by SCS, WTSC Carto Unit from USGS 1:500,000 series.
Thematic detail compiled by state staff.

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Prime forestland is defined as land that has soil capable of growing wood at the rate of 85 cubic feet or more/acre/year based on the average annual growth rate in natural stands.

Although there are possibly a few sites within the Montane conifer and spruce-fir vegetation zones with the potential of meeting the prime forest land criteria, none have been identified within the Basin.

Unique timberlands are those which grow tree species capable of producing specialized wood products. There are no known areas in the Little Colorado River Basin which meet this criterion.

Timberlands of statewide and/or local importance are those which are important to the economy of a state or local area and to the social well-being of the residents. In the Little Colorado River Basin, all communities within and adjacent to forested lands are largely dependent upon the recreation, timber and wildlife values. The majority of these forest lands are within the National Forest system. During the formulation and evaluation of planning alternatives for these lands, many factors are considered: namely social, economic, environmental, etc. The need to retain prime and important forestlands will be considered as part of this evaluation.

Other pertinent data relative to forestland is given in Appendix IV, Section 3, "TIMBER."

PRIME WOODLAND

Criteria has not been established for prime woodland, which consist basically of juniper-pinon in the Little Colorado River Basin. In recent years, management emphasis has shifted from that of 100% livestock production to a multiple-use or mixed objectives. This vegetation community is currently recognized as an important source of energy (fuelwood) and as important habitat for wildlife.

The potential production capacities of prime woodland are approximately: 15 cubic feet per acre per year of wood, 600 pounds of forage per acre per year (dry cut), 2.0 inches of water yield per year, important habitat for three native game species, and low (value) dispersed recreation use. (Also, see Appendix IV, Section 3, "TIMBER," for additional information on woodland production and uses.)

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SECTION 2

SOCIO-ECONOMIC BASE

SECTION 2

SOCIO-ECONOMIC BASE

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SECTION 2

SOCIO-ECONOMIC BASE

HISTORICAL DEVELOPMENT

The economy of the Little Colorado River Basin was originally founded on livestock production and forestry. In recent decades, forest products and tourism have contributed a large share of the income of the people of the Basin. The development history of the Little Colorado Basin has been very much like that of Arizona as a whole. It has been described by the Arizona Department of Water Resources (formerly Arizona Water Commission) in a recent report as follows:

> In the years immediately preceding the Civil War, pioneers began to migrate to Arizona in significant numbers. As the Indians did before them, they excavated irrigation canals in the Salt River Valley; additionally, they grazed cattle in the Southeastern Arizona Grasslands, and began to explore for gold, silver, and copper deposits in the rugged mountain areas. The Southern Pacific and Santa Fe Railroads extended their rail systems into Arizona thereby enabling farmers, ranchers, and miners to market their products. These early ventures provided the basis of an economy that would prevail in Arizona through the first half of this century.
>
> Following World War II, Arizona experienced another large influx of people that would, in a short time, appreciably alter the economic pattern of the previous 80 years. Highway and commercial air transportation provided unlimited access to Arizona's climate and resources. Manufacturing and tourism joined agriculture and mining as the principal economic activities in Arizona. By the late 1950's and early 1960's Arizona led the nation in growth of manufacturing employment and the State's outstanding scenic and recreational resources led to the establishment of a tourist related economic activity. 1/

The above quote described the economy of the State of Arizona generally. The Little Colorado River Basin is much the same except that it contains very little irrigated agriculture and manufacturing. In 1976, Maricopa (Phoenix) and Pima (Tucson) counties alone had 1806 of the State's 2229 manufacturing firms. (Coconino, Navajo and Apache Counties together accounted for 126 of these.) Only 29,870 acres of the Arizona part of the Basin and about 4950 acres of the New Mexico part of the basin are irrigated. About 59 percent of the Basin is rangeland, 8 percent conifer timber, 30 percent pinon-juniper woodland and about 3 percent is cultivated agriculture, urban, remote subdivisions, etc.

In recent years tourism has increased in importance as a source of income to Basin residents. The climate enables the Basin to attract tourists on a year round basis. Recreational opportunities include such activities as

1/ Arizona Water Commission, Phase I - Arizona State Water Plan - Inventory of Resource and its Uses, July 1975, page 13.

camping, boating, golfing, hunting, fishing and skiing. There are many national parks and monuments in the Basin providing widespread sightseeing opportunities. Seasonal home building has brought many Arizona residents, especially from Phoenix and Tucson, into the area in recent years and provided much employment. Flagstaff, Show Low, and the Lakeside-Pinetop areas have had much of the seasonal home growth.

Factors limiting the economic growth of the Basin include its sparse and underemployed population, limited water supplies, rugged mountain terrain, and distance from population centers. With the development of highways and railways in the early 1900's the effect of distance was overcome to some extent. However, the lack of job opportunities prevented rapid growth and still is a limiting factor.

Another factor affecting growth has been the sheer magnitude of land area from which free enterprise development forces have been restricted. This includes land owned by the federal government, state government and Indian reservations. From a state and national perspective, however, this outside control has been beneficial in that it has helped to preserve timber resources and reduce overgrazing of range lands, particularly on federally managed lands. On certain state and Indian owned lands, however, overgrazing or mismanagement has occurred for many years. Overgrazing continues to be a serious problem on most parts of the Navajo Reservation today. More recently, this trend has reversed as Indian groups, and private owners and operators have been working together with Federal and State agencies to develop effective range and timber management and conservation programs that will benefit the local economy as they are implemented over the long run.

POPULATION

The population of Apache, Coconino, and Navajo Counties in 1975 of 167,300 was about two and one-half times the 1940 level of 68,174. During the same period the population of Catron, McKinley and Valencia Counties in New Mexico doubled from 48,767 to 99,500 (Table 2-1 and Figures 2-1 and 2-2).

The population of the Arizona portion of the Little Colorado River Basin increased fairly steadily in each of the three counties. Catron County in the New Mexico portion showed some up and down fluctuation. Catron's population declined from 4,881 in 1940 to 2,200 in 1970. Since 1970 it has been gaining slowly and may reach almost 6,000 by 1990 according to projections made in 1968.

Projections published in September 1979 by the Bureau of Business and Economic Research show more conservative projections for Catron County. The New Mexico Bureau of Business Research report was published after the projections had been chosen for this report. The Bureau's projections for the New Mexico counties are shown in Table 2-2 for comparison.

It should be noted that data for future years are projections of past trends with some modification based on expected economic growth. The numbers in the tables should not be taken as absolute predictions. They are to be used as indicators of the direction of change based on past performances. Accurate

TABLE 2-1
HISTORICAL AND PROJECTED POPULATION OF WHOLE COUNTIES HAVING LAND IN THE LITTLE COLORADO RIVER BASIN, 1940-2020
(COUNTYWIDE DATA)

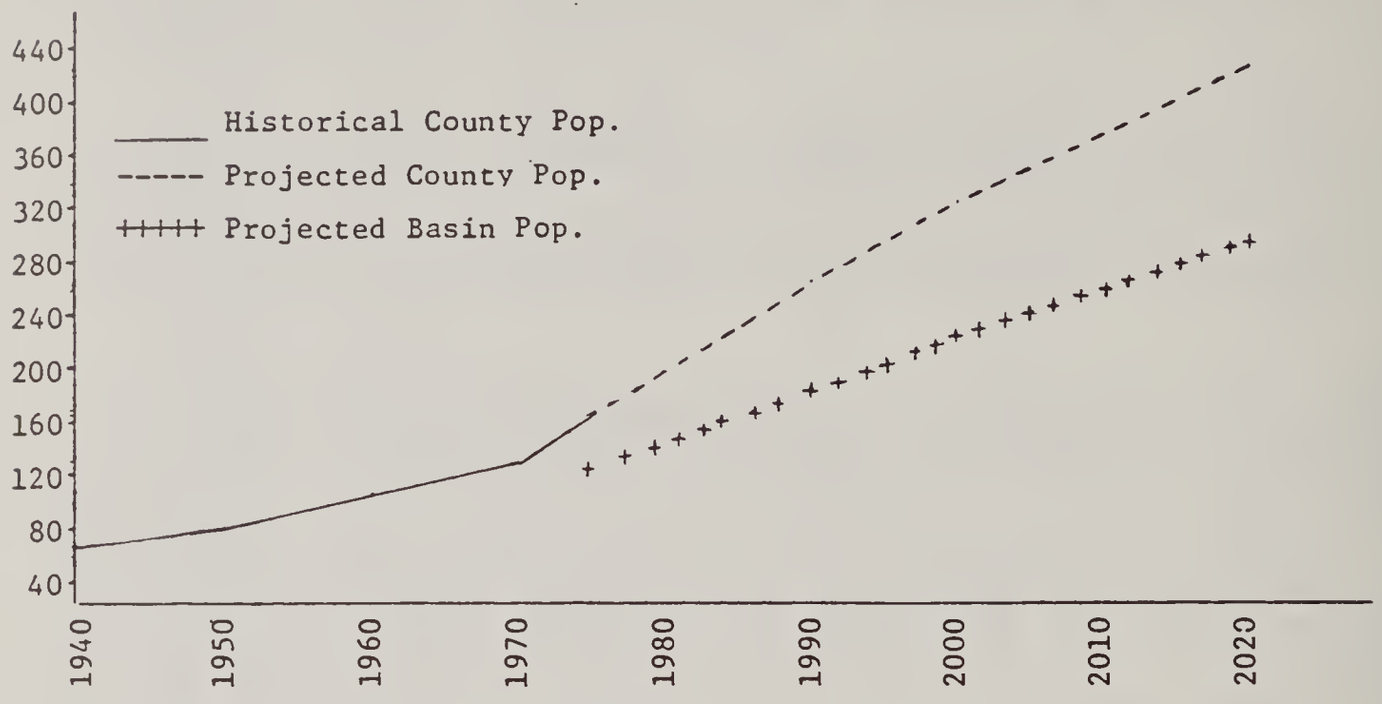
ITEM	UNITS	1940	1950	1960	1970	1975	1990*	2000*	2020*
Period	No. Years	-	10	10	10	5	15	10	20
AREA									
Apache County	No. (000)	24.1	27.8	30.4	32.3	41.0	64.9	79.0	95.9
Avg. Ann. Rate	Pct.	-	1.5	.9	.6	1.4	3.9	2.2	1.0
Coconino County	No. (000)	18.8	23.9	41.9	48.3	67.3	108.8	137.6	180.1
Avg. Ann. Rate	Pct.	-	2.7	7.5	1.5	7.9	4.1	2.6	1.5
Navajo County	No. (000)	25.3	29.4	38.0	47.7	59.0	91.0	114.2	149.6
Avg. Ann. Rate	Pct.	-	1.6	2.9	2.6	4.7	3.6	2.5	1.6
ARIZONA TOTAL	No. (000)	68.2	81.1	110.3	128.3	167.3	264.7	330.8	425.6
Avg. Ann. Rate	Pct.	-	1.9	3.6	1.6	6.0	3.9	2.5	1.4
Catron County 1/	No. (000)	4.9	3.5	2.8	2.2	2.3	5.9	9.3	11.9
Avg. Ann. Rate	Pct.	-	-2.9	-2.0	-2.1	.5	3.8	5.8	1.4
McKinley County 1/	No. (000)	23.6	27.5	37.2	43.2	51.2	73.5	88.2	145.0
Avg. Ann. Rate	Pct.	-	1.7	3.5	1.6	3.7	2.9	2.0	3.2
Valencia County 1/	No. (000)	20.2	22.5	39.1	40.5	46.0	72.0	86.5	147.4
Avg. Ann. Rate	Pct.	-	1.1	7.4	.4	2.7	3.8	2.0	3.5
NEW MEXICO TOTAL	No. (000)	48.7	53.5	79.1	85.9	99.5	151.4	184.0	304.3
Avg. Ann. Rate	Pct.	-	1.0	4.8	.9	3.2	3.5	2.2	3.3

*Projected data.

Source: Historical data is from the Bureau of the Census; Projected data were developed by the Arizona Department of Water Resources for the Arizona Counties and by the Bureau of Business and the Bureau of Reclamation in cooperation with the State of New Mexico for the New Mexico Counties.

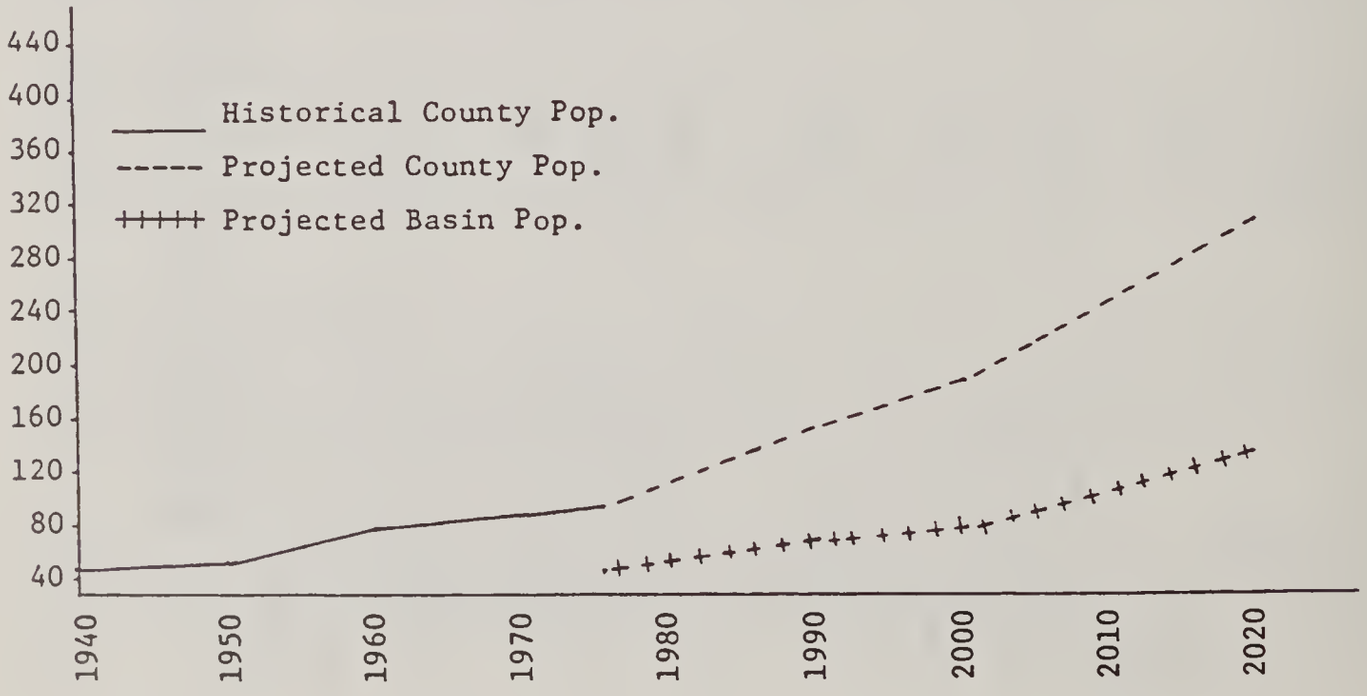
1/See Table 2-2 for more recent projections for the New Mexico Counties.

FIGURE 2-1: HISTORICAL AND PROJECTED POPULATION IN THREE ARIZONA COUNTIES AND IN THE LITTLE COLORADO BASIN (ARIZONA PORTION)



Source: Census of Population, Bureau of the Census, U.S. Department of Commerce and Arizona Department of Water Resources

FIGURE 2-2: HISTORICAL AND PROJECTED POPULATION IN THREE NEW MEXICO COUNTIES AND IN THE LITTLE COLORADO BASIN (NEW MEXICO PORTION)



Source: Census of Population, Bureau of the Census, U.S. Department of Commerce and the Bureau of Business and Economic Research, University of New Mexico.

TABLE 2-2

BUREAU OF BUSINESS AND ECONOMIC RESEARCH POPULATION PROJECTIONS FOR NEW MEXICO COUNTIES HAVING LAND IN THE LITTLE COLORADO RIVER BASIN

(COUNTYWIDE DATA)

County	1975	1990	2000
Catron	2,300	3,100	3,600
McKinley	51,200	83,900	104,000
Valencia	46,000	73,100	90,300

Source: Bureau of Business and Economic Research, "Population Estimates and Projections: 1970-2000; Counties and Waste Water Facility Planning Areas," by Lynn Wombold with John Temple, University of New Mexico, September 1979.

forecasting would require a much more in-depth study, and would be useful only for short-term planning purposes. Such in-depth study was not possible for this report.

The planning team decided to continue with the projections shown in Table 2-1. Although Catron's projections are significantly different percentage-wise, the absolute difference is less than 6,000 people in the year 2000. This study's projections are within 15 percent of the Bureau's 1979 projection for McKinley and within 5 percent for Valencia for the year 2000.

Population increases are usually due to job opportunities which keep local youth in the area and entice new workers to move in. Historically, much of the Little Colorado Basin population has depended on beef cattle, timber and mining for its livelihood. In recent decades tourism has begun to be a significant factor in the economic base of the Little Colorado Basin. It is expected to become more significant in the future but its impact may be dampened somewhat by rising fuel prices.

The largest population in the entire Little Colorado Basin is in and around Flagstaff in Coconino County, Arizona. As shown in Table 2-1, Coconino made a very large population gain between 1950 and 1960 with an average annual rate of growth of 7.5 percent. Its population growth was rather slight from 1960 to 1970 but shows another spurt from 1970 to 1975 at an annual rate of 7.9 percent. Coconino County's population is expected to increase by about 168 percent between 1975 and 2020 and that of Flagstaff by about 149 percent. These numbers would of course be affected by any change in the City's boundaries which would include more of the County's population within the City.

Population projections were made by different procedures in Arizona and New Mexico. This accounts for some of the disparity between the projections for Gallup, New Mexico and Flagstaff, Arizona. Gallup is the second largest city in the Little Colorado Basin and the largest in the New Mexico part. The projections in Table 2-3 show that its population may rise by more than 5 times between 1975 and 2020. Flagstaff's economic base contains significant tourism, educational and lumbering business and has a growing manufacturing sector. Gallup has significant coal and uranium resources nearby which will play a large role in its future growth.

Zuni, New Mexico also is expected to grow by about 5 times by 2020 (Table 2-3). Both McKinley County and Valencia County will grow as a result of higher demands for coal and uranium.

A recent population report by the New Mexico Bureau of Business and Economic Research makes the following observation regarding migration trends. 1/

> Large metropolitan centers in the West have experienced out-migration during the 1970's, and in-migration to California has slowed significantly. At the same time, in-migration to smaller metropolitan counties and less populous states, like New Mexico, has increased.
>
> Clearly, a preference for less populated areas--primarily in the South and West--has impacted population growth and redistribution in the 1970's.
>
> . . . there is also evidence of increasingly complex forces underlying the shift in migration. Economic growth cannot account for the fact that entirely rural counties (with no place of 2,500 or more) were the fastest growing areas from 1970 to 1977.
>
> . . . . Like the smaller metropolitan areas in the South and West, population growth in the Albuquerque SMSA has generally exceeded growth in the non-metropolitan counties. The exceptions to this trend include counties with economic specializations such as energy resources production (McKinley, San Juan and Valencia Counties) . . . .
>
> . . . . The major underlying causes for the growth (in New Mexico) can be traced to two related phenomena that surfaced in the early 1970's: The deterioration of the nation's fossil-based fuel balance and the unprecedented migration of families to the 'Sunbelt' states.

1/ Lynn Wombold with John Temple, "Population Estimates and Projections: 1970-2000, Counties and Wastewater Facility Planning Areas," Bureau of Business and Economic Research, University of New Mexico, September 1979, pp. 15-19.

TABLE 2-3

POPULATION PROJECTIONS FOR MAJOR CITIES AND COMMUNITIES
LITTLE COLORADO RIVER BASIN[1]/

CITY	COUNTY	STATE	POPULATION			
			1975	1990	2000	2020
Flagstaff	Coconino	AZ	31,370	47,920	57,970	78,000
Gallup	McKinley	NM	16,948	41,400	54,800	100,000
Winslow	Navajo	AZ	7,663	10,500	12,830	15,580
Zuni	McKinley	NM	5,377	10,350	13,900	25,500
Holbrook	Navajo	AZ	5,093	7,000	8,570	10,380
Pinetop	Navajo	AZ	4,100	6,742	7,680	9,420
Show Low	Navajo	AZ	3,378	5,581	6,930	8,440
Snowflake	Navajo	AZ	2,573	4,257	5,310	6,490
Eagar	Apache	AZ	1,962	3,350	4,700	5,800
St. Johns	Apache	AZ	1,838	4,500	5,110	6,340
Taylor	Navajo	AZ	1,501	2,481	3,160	3,900
Springerville	Apache	AZ	1,420	2,350	3,280	4,050
Joseph City	Navajo	AZ	1,000	1,100	1,150	1,300
Ft. Defiance, Window Rock & St. Michaels	Apache	AZ	5,400	7,780	9,990	17,400
Crownpoint	McKinley	NM	900	900	900	900
Lakeside	Navajo	AZ	900	1,600	2,500	2,900
Hotevilla	Navajo	AZ	900	1,050	1,200	1,500
Overgaard	Navajo	AZ	800	1,300	1,660	2,150
Tuba City	Coconino	AZ	4,600	7,450	9,350	12,300
Oraibi (New)	Navajo	AZ	600	840	1,100	1,800
Heber	Navajo	AZ	500	825	1,050	1,350
Polacca	Navajo	AZ	500	560	600	700
Shumway	Navajo	AZ	200	650	750	900
Gamerco	McKinley	NM	400	400	400	400
Quemado	Valencia	NM	350	375	450	500

1/ The numbers are projections of past trends only and are not predictions. Many unforeseeable variables will affect actual population changes in the future.

Source: Estimates by ERS-USDA based on County and Water Use Area Projections by the Arizona Department of Water Resources (formerly the Arizona Water Commission).

The bureau report goes on to say that, clearly, the New Mexico economy has turned around since 1970. The State experienced a rise in total personal income of 123 percent between 1970 and 1977. Only seven states exceeded this. This is in contrast to a growth in personal income of only 63 percent between 1959 and 1969.

Both McKinley and Valencia counties can expect growth due to increased demand for coal. However, some of this growth will occur outside the Little Colorado River Basin. Valencia County in particular will feel the influence of the expanding Albuquerque economy in its eastern portion outside the Basin.

AGE AND SEX DISTRIBUTION

Since 1940 all six counties have had significant increases in the female population relative to males. For example, Apache County, Arizona was 48.4 percent female in 1940 and had increased to 50.8 percent female by 1970 (Table 2-4). All counties had increases in the 65 and older age group also, with Catron County, New Mexico having the most pronounced increase. Catron County's male population 65 and older went from 5.2 percent in 1940 to 12.5 percent in 1970 (Table 2-5). Catron was also much heavier in the 45-64 age group in 1970 than it was in 1940. Apparently the younger age groups experienced more out-migration than the older age groups.

POPULATION BY WATER USE AREA

The Arizona Department of Water Resources has delineated boundaries for "Water Use" areas throughout the State (See Water Use Areas Map following page 2-10). Fifteen of these water use areas have all or part of their territory inside the Little Colorado River Basin. The Arizona Department of Water Resources recently prepared population projections for each of the Water Use Areas. These projections were the basis for estimating the population inside the Arizona part of the Basin (Table 2-6). It was necessary to adjust the population downward for those Water Use Areas having area outside. The data in Table 2-6 reflect the results of these estimates and show only the estimated population inside. Chinle Valley, Black Mesa and Kaibito Plateau had large areas outside the Basin. Very small adjustments were made in Bodaway Mesa and San Francisco Peaks Areas.

Population estimates for the New Mexico Hydrologic Subareas (Water Use Areas Map and Table 2-7) were made by the New Mexico State Engineer's office. They are based on projections for counties made by Edgel in 1968. 1/

The populations inside and outside the Little Colorado Basin for each of the six counties involved are shown in Table 2-8.

1/ Ralph L. Edgel, "Projections of the Population of New Mexico and Its Counties to the Year 2070," Bureau of Business Research, The University of New Mexico, July 1968, p. 41. More recent estimates by the same office are now available; see footnote on page 6.

TABLE 2-4

POPULATION AGE DISTRIBUTION, ARIZONA COUNTIES
LITTLE COLORADO RIVER BASIN

(COUNTYWIDE DATA)

Age Group	1940 Male	1940 Female	1970 Male	1970 Female
	----------Percent----------			
Apache County, AZ				
19 or younger	50.6	52.7	55.3	53.5
20 to 44 years	34.7	34.2	27.2	29.4
45 to 64 years	11.3	10.2	12.8	12.4
65 and older	3.4	2.9	4.6	4.7
All Ages	51.6	48.4	49.2	50.8
Coconino County, AZ				
19 or younger	42.1	47.2	45.2	46.3
20 to 44 years	38.5	37.5	35.9	34.8
45 to 64 years	14.9	12.1	14.6	14.5
65 and older	4.5	3.2	4.4	4.4
All Ages	51.8	48.2	49.6	50.4
Navajo County, AZ				
19 or younger	47.2	50.0	53.0	50.1
20 to 44 years	34.2	34.5	26.7	29.5
45 to 64 years	14.1	11.8	14.7	15.0
65 and older	4.4	3.8	5.7	5.4
All Ages	51.7	48.3	49.5	50.5

Source: Census of Population, Bureau of Census, U.S. Department of Commerce.

TABLE 2-5

POPULATION AGE DISTRIBUTION, NEW MEXICO COUNTIES
LITTLE COLORADO RIVER BASIN

(COUNTYWIDE DATA)

Age Group	1940 Male	1940 Female	1970 Male	1970 Female
	---------- Percent ----------			
Catron County, NM				
19 or younger	40.9	47.3	39.2	36.9
20 to 44 years	36.9	36.7	24.7	27.5
45 to 64 years	17.0	13.0	23.6	23.5
65 and older	5.2	3.0	12.5	12.1
All Ages	54.2	45.8	50.9	49.1
McKinley County, NM				
19 or younger	46.7	48.8	52.7	50.9
20 to 44 years	35.5	36.9	29.1	31.7
45 to 64 years	14.0	11.2	13.9	12.9
65 and older	3.8	3.1	4.3	4.5
All Ages	51.0	49.0	48.4	51.6
Valencia				
19 or younger	48.0	50.0	48.3	47.2
20 to 44 years	32.9	34.4	30.5	31.8
45 to 64 years	14.1	12.1	15.5	15.5
65 and older	5.0	3.5	5.7	5.5
All Ages	51.3	48.7	50.0	50.0

Source: Census of Population, Bureau of Census, U.S. Department of Commerce

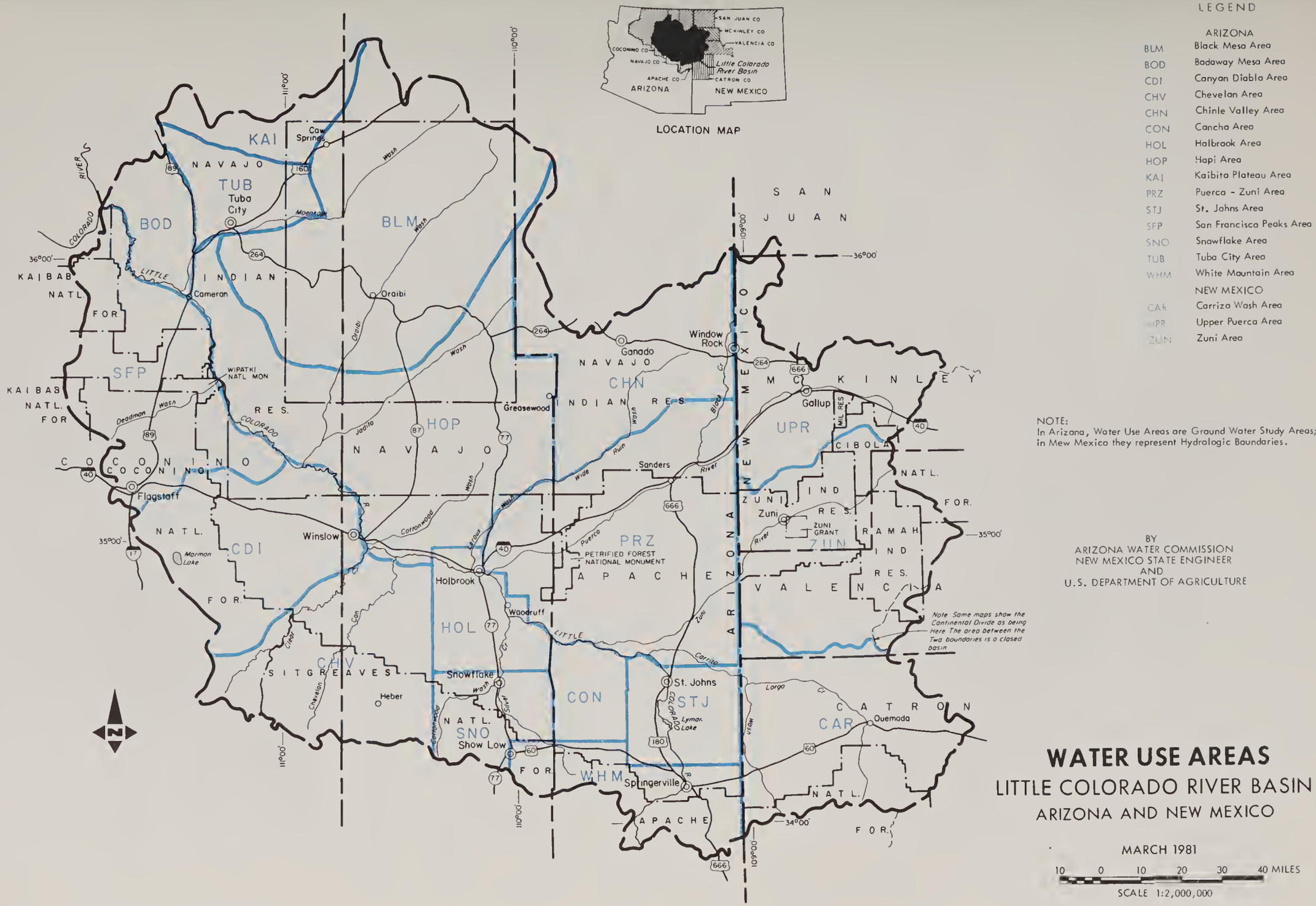
TABLE 2-6

POPULATION IN THE LITTLE COLORADO RIVER BASIN
BY WATER USE AREA, ARIZONA PORTION

(BASIN DATA)

WATER USE AREA	HISTORICAL	PROJECTED		
	1975	1990	2000	2020
1. BLM - Black Mesa	13,572	20,100	24,195	31,500
2. BOD - Bodaway Mesa	980	1,600	2,010	2,670
3. CDI - Canyon Diablo	7,963	11,000	13,470	16,480
4. CHN - Chinle Valley	16,800	20,224	24,270	32,260
5. CHV - Chevelon	1,700	2,725	3,440	4,500
6. CON - Concho	175	950	1,120	1,400
7. HOL - Holbrook	7,293	10,200	12,240	14,920
8. HOP - Hopi	8,120	12,500	15,800	20,750
9. KAI - Kaibito Plateau	2,200	3,040	3,830	5,300
10. PRZ - Puerco-Zuni	750	1,545	1,930	2,300
11. SFP - San Farncisco Peaks	34,370	55,000	67,470	91,700
12. SNO - Snowflake	5,699	8,988	11,090	13,690
13. STJ - St. Johns	2,088	4,050	5,700	7,090
14. TUB - Tuba City	7,100	11,450	14,400	18,100
15. WHM - White Mountains	13,110	21,623	27,350	33,105
BASIN TOTAL (ARIZONA)	121,920	184,995	228,315	295,765

Source: Arizona Department of Water Resources - with adjustments by USDA-ERS to reflect population inside the Little Colorado River Basin.



LEGEND

ARIZONA

BLM	Black Mesa Area
BOD	Badaway Mesa Area
CDI	Canyon Diablo Area
CHV	Chevelan Area
CHN	Chinle Valley Area
CON	Concha Area
HOL	Holbrook Area
HOP	Hopi Area
KAI	Kaibita Plateau Area
PRZ	Puerco - Zuni Area
STJ	St. Johns Area
SFP	San Francisco Peaks Area
SNO	Snowflake Area
TUB	Tuba City Area
WHM	White Mountain Area

NEW MEXICO

CAR	Carriza Wash Area
UPR	Upper Puerco Area
ZUN	Zuni Area

NOTE:
In Arizona, Water Use Areas are Ground Water Study Areas; in New Mexico they represent Hydrologic Boundaries.

BY
ARIZONA WATER COMMISSION
NEW MEXICO STATE ENGINEER
AND
U.S. DEPARTMENT OF AGRICULTURE

Note Some maps show the Continental Divide as being Here The area between the Two boundaries is a closed basin

WATER USE AREAS
LITTLE COLORADO RIVER BASIN
ARIZONA AND NEW MEXICO

MARCH 1981

10 0 10 20 30 40 MILES

SCALE 1:2,000,000

Source:
Base map prepared by SCS, WTSC Carta Unit from USGS 1:500,000 series.
Thematic detail compiled by state staff.
U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE USDA SCS PORTLAND, OR 1981

M7-0L-24030-18

TABLE 2-7

POPULATION IN THE LITTLE COLORADO RIVER BASIN BY HYDROLOGIC SUBAREA, NEW MEXICO PORTION

(BASIN DATA)

HYDROLOGIC AREA	HISTORICAL 1975	PROJECTED 1990	PROJECTED 2000	PROJECTED 2020
1. UPR - UPPER PUERCO	33,800	49,600	62,100	104,400
2. ZUN - ZUNI	6,950	11,600	15,050	27,500
3. CAR - CARRIZO WASH	550	555	650	750
4. BASIN TOTAL (NEW MEXICO)	41,300	61,755	77,800	132,650

Source: County Profiles for Catron, McKinley and Valencia Counties. Published by the New Mexico Interstate Stream Commission and the New Mexico State Engineer Office 1975.

DEVELOPING AREAS

Portions of the Little Colorado River Basin may develop rapidly in the next 10 to 20 years due to tourism, second home building, mining and manufacturing. Growth in some areas will be spurred by the construction of new electric generating plants or add-on units to existing plants. As of this writing, however, rapidly rising fuel costs are having a negative effect on tourism and high interest rates (the prime is 20 percent) are causing a tight mortgage money market. It is likely that these factors will slow development somewhat over the short term.

A recent Northern Arizona Council of Government (NACOG) study summarizes the economy of the four county region as follows (16):

> The economy of the NACOG region (Apache, Coconino, Navajo and Yavapai Counties) is a complex one. Because of the distances and cultural diversity involved, there appears to be a series of many small economies operating independently but in reality there is a great deal of economic mobility. This is demonstrated by such phenomena as the long journeys to work which take place from the Verde Valley to Flagstaff or from Show Low to St. Johns. Additionally, long distances are traveled--sometimes regularly--for the purposes of shopping and recreating. There is a great deal of quiet economic interaction across northern Arizona.

TABLE 2-8

POPULATION INSIDE AND OUTSIDE THE LITTLE COLORADO RIVER BASIN
BY COUNTY, 1975 AND PROJECTIONS

(COUNTYWIDE & BASIN DATA)

Item	1975	1990	2000	2020
	---------- 1,000's ----------			
Apache County, AZ	41.0	64.9	79.0	95.9
In	23.9	34.0	41.7	53.8
Out	17.1	30.9	37.3	42.1
Coconino County, AZ	67.3	108.8	137.6	180.1
In	48.0	75.5	93.0	125.0
Out	19.3	33.3	44.6	55.1
Navajo County, AZ	59.0	91.0	114.2	149.6
In	48.9	74.4	91.2	114.6
Out	10.0	16.6	23.0	35.0
ARIZONA TOTAL	167.3	264.7	330.8	425.6
In	120.9	183.9	225.9	293.4
Out	46.4	80.8	104.9	132.2
Catron County, NM	2.3	5.9	9.3	11.9
In	.5	.5	.6	.6
Out	1.8	5.4	8.7	11.3
McKinley County, NM	51.2	70.8	88.2	145.0
In	39.8	60.5	76.2	130.0
Out	11.4	10.3	12.0	15.0
Valencia County, NM	46.0	25.9	86.5	147.4
In	1.0	1.0	1.0	2.0
Out	45.0	74.9	85.5	145.4
NEW MEXICO TOTAL	99.5	152.6	184.0	304.3
In	41.3	62.0	77.8	132.6
Out	58.2	90.6	106.2	171.7
SIX COUNTY TOTAL	266.8	417.3	514.8	729.9
In	162.2	245.9	303.7	426.0
Out	104.6	171.4	211.1	303.9

Source: Arizona Department of Water Resources with adjustments by USDA-ERS to reflect population inside the Little Colorado River Basin.

This fact highlights what may be the region's greatest economic weakness in a period of increasing energy costs. The northern Arizona economy, particularly that large proportion reliant upon tourists and travelers, is extremely sensitive to changes in national travel and vacation patterns. Much of the trade in Flagstaff, Holbrook, Winslow and Show Low is the result of Indians from the reservations who journey long distances to shop for staples such as food, clothing and building materials. They are attracted (not only) by a greater selection, but also by lower prices than are available on the reservation. Significant increases in transportation costs may be enough to steer them to reservation stores. The auto-oriented highway commercial developments in Holbrook, Winslow, Flagstaff and Williams would certainly be affected if the train replaced the automobile as the primary mode of cross country travel. This is of course speculation, but the reliance of much of northern Arizona's economy upon cheap transportation is undeniable. The total estimated expenditures by travelers and tourists in the NACOG region in 1975-76 was nearly $400,000,000, the vast majority of which was spent by auto-borne visitors. The magnitude of this becomes more apparent when one realizes that the total personal income in the region in 1976 was only $710,419,000.

According to figures presented in the NACOG report entitled "Seasonal Population in Northern Arizona Communities," (9) marked seasonal shifts in population affect many communities throughout the Little Colorado River Basin area. This seasonal buildup in population, particularly during the peak summer months, puts additional pressure on community services and facilities, as well as natural resources. As this pressure increases, environmental quality may be degraded unless communities plan carefully to handle the development. Individual communities bear the first line responsibility to protect the resources that bring visitors to the area--the region's natural beauty and clean air. Any area that is growing rapidly experiences planning and coordination problems as private entrepreneurs seek to capitalize on economic opportunities, in restaurants, motels, condominiums, second homes and as retail sales develop rapidly to meet the demand. Much pressure comes to bear on local planning, zoning and building code authorities as they attempt to guide development for the long term benefit of present and future residents.

The seasonal buildup of population is very impressive in some localities. On a peak summer weekend Navajo County may have an additional 30,000 people added to its normal population of 62,000. Most communities will have a summer increase of about 25 percent above their normal population with a few having over 100 percent increases and some as much as 400 percent.

For information about specific communities, the reader should consult the Esposito (NACOG) Report.

ELECTRIC GENERATING STATIONS

There are three electric generating stations under various stages of planning, construction and operation in the Little Colorado River Basin. These facilities provide stimulus to the local economies by creating employment during

both the construction and operating phases. Most of the power to be generated will be exported outside the local economic area. Therefore new population may not move into these localized areas as a direct result of the power generated.

Cholla 5 Station

The Cholla 5 facility will be a 350 megawatt plant located two miles east of Joseph City, Arizona at the Arizona Public Service Project Site. 1/ It will be the 5th unit to be constructed at the site. Like the other units it will be coal fired with all coal being delivered to the site by rail. Construction of Unit 5 will begin in 1980 as construction of Unit 4 nears completion. There will be an average of over 600 workers employed in Cholla 5 from mid-1981 to mid-1982. 2/ Cholla 5 is expected to go on line in 1983.

Capital investment in Cholla 5 will be about $345 million of which about $90 million is for construction payroll costs.

The construction of Cholla 2, 3, and 4 has added significantly to income in Navajo County. About one-half of the 655 Cholla 4 construction workers have moved to Navajo county with most living in Joseph City, Holbrook, Snowflake and Show Low.

The local economy is heavily dependent on tourism which is heaviest in summer. The Cholla construction has and will continue to help offset the seasonal downturns in the economy during fall, winter, and spring. The permanent increase in Arizona Public Service Company employment is a benefit to the area. The major industrial sectors in Holbrook in 1975 were retail trade (30 percent of employment), services (31 percent), and public administration (18 percent). The major sectors in Winslow in 1975 were transportation and communication (40 percent) and retail trade (31 percent). In 1975 about 1200 jobs in Navajo County were related to tourism and travel. About 370 of these were in the lodging industry and 430 in the food industry. 3/

The assessed value of property in Holbrook increased from $6.4 million in 1972 to $9.2 million in 1976. For the Joseph City area the increase was from $1.1 to $1.5 million over the same period. 4/

Coronado Station

The Salt River Project is constructing a new generating facility north of St. Johns in Apache County known as the Coronado Station. The third unit (Unit 3) is presently under construction; it follows two earlier units on

1/ Dames and Moore, "Cholla 5 Socio-Economic Study," Arizona Public Service Company, Phoenix, Arizona, June 1977, p. 1.1.

2/ Ibid., p. 3.1.

3/ Ibid., p. 3.18.

4/ Ibid., p. 3.39.

which construction started in 1975. Unit 3, started during 1979, is planned to come on line in 1984 or 1985. Each of the three units has 350 megawatt capacity.

In 1978, at the peak of the construction period for Units 1 and 2, there were about 3,000 people employed. Stable operating employment for all three units combined is expected to be about 450 people.

Most of the energy produced by this facility will feed into the Salt River System, but about 200 megawatts has been planned to be sold to southern California.

There are social impacts of the Coronado facility from the buildup of construction workers during the construction phase which started in 1975. 1/ Schools, for example, expanded their staff and physical plant to accommodate the population buildup. New firms have been started creating more employment opportunities while local government expanded to provide the needed services. The housing sector expanded by providing new mobile home parks and many new conventional homes. The communities around St. Johns have felt some impact also as some workers chose to live elsewhere and commute to the construction site.

The largest number of commuters come from the Springerville-Eagar area, followed by Concho Valley, Show Low, Lakeside-Pinetop, Snowflake-Taylor, and Holbrook-Joseph City in that order. A total of almost 270 people were commuting into the construction site near St. Johns in 1976. In 1976 the total employment was 979 with 542 of these employed in contract construction. The impact, by sector, on the St. Johns economy between 1974 and 1976 is demonstrated by the following table taken from the report prepared by Richard C. Fuller and Associates for the Salt River Project (Table 2-9).

Another table taken in its entirety from the Fuller report gives some indication of the relative impact of construction of Units 1 and 2 on the towns surrounding St. Johns (Table 2-10).

Springerville Electric Generating Station 2/

The Tucson Electric Power Company has initiated construction on the first of three generating units to be built at a site about 10 miles north of Springerville. The schedule of construction is stretched over about 15 years to avoid sudden sharp fluctuations in the population. The first unit is scheduled for completion in 1985, the second in 1988 and the third in 1991. All power will be transported to other areas of Arizona.

1/ This discussion is based on data from "Coronado Generating Station: Socio-Cultural and Economic Study," prepared by Richard C. Fuller Associates for the Salt River Project, Phoenix, Arizona, March 1977.

2/ This discussion and data is from "Springerville Generating Station--Socio Economic Analysis" prepared by the Tucson Electric Power Co. (formerly Tucson Gas and Electric).

TABLE 2-9

ST. JOHNS, ARIZONA: AVERAGE TOTAL EMPLOYMENT, BY SECTOR IN 1974 AND 1976

Sector	Full-Time Employees 1974	1976
Agriculture and Agricultural Services	--	--
Contract Construction	4	542
Manufacturing	22	24
Mining	--	--
Restaurants and Bars, Service Stations	24	39
Hotels, Motels	0	12
Other Services	8	38
General Retail Trade	42	70
Wholesale Trade	17	3
Finance, Insurance, Real Estate	15	33
Transportation, Utilities and Communication	3	33
Local Government and Public Schools	156	185
TOTAL	291	979

Source: From Table 3, page 35 of the Richard C. Fuller report entitled "Coronado Generating Station: Socio-Cultural and Economic Study" March, 1977.

The Springerville Generating Station will continue the same types of demographic and socio-economic effects initiated by construction of the Coronado plant in St. Johns.

Employment of craftsmen, laborers and operations employees is expected to occur as indicated in Table 2-11. Note there are three different two-year plateaus where employment is highest. These occur in 1983-84, 1986-87, and 1989-90. Permanent employment to operate and maintain the plant will be about 350 for all three units.

Additional employment in retailing and services will be induced by the increase in direct employment due to the new facility. Table 2-12 shows the estimated indirect (or induced) employment from 1979 to 1993. It is expected that the indirect employment due to the plant will stabilize at about 320 by 1993.

TABLE 2-10

ST. JOHNS, ARIZONA: ESTIMATED NUMBER OF IN-COMMUTERS BY PLACE OF RESIDENCE

Sector	Concho	Concho Valley	Show Low	Springerville-Eagar	Lakeside-Pinetop	Snowflake-Taylor	Holbrook-Joseph City	Winslow
Agriculture and Agricultural Services	-	-	-	-	-	-	-	-
Contract Construction	29	32	21	71	16	13	16	5
Manufacturing			2	3				
Mining								
Restaurants and Bars, Service Stations				2	1			
Hotels, Motels	1							
Other Services			1					
General Retail Trade	5					5		
Wholesale Trade								
Finance, Insurance, Real Estate			1	3				
Transportation, Utilities and Communication					1			
Local Government and Public Schools	4	2		13	1		1	
TOTAL	39	34	25	92	19	18	17	5
	15	13	9	35	7	7	6	2

Source: Table 11 of the Richard C. Fuller Report entitled "Coronado Generating Station: Socio-Cultural and Economic Study" based on a survey taken in November, 1976; Construction sector estimates are based on Bechtel Survey of 9-13-76.

TABLE 2-11

WORK FORCE REQUIRED TO CONSTRUCT AND OPERATE THE SPRINGERVILLE GENERATING STATION (ANNUAL PEAKS)[1/]

Work Force Classification	Project Year														
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Direct															
Construction Craftsmen	20	90	110	540	770	770	330	620	640	290	580	580	260	0	0
Construction Non-materials	0	15	25	110	150	150	65	120	120	55	110	110	50	0	0
Operation and Maintenance	0	0	0	0	0	0	170	170	170	250	250	250	350	350	350
Total	20	105	135	650	920	920	565	910	930	595	940	940	660	350	350

1/ Ibid., p. 6.67, Table 6.2-15.

TABLE 2-12

SCHEDULE OF INDIRECT EMPLOYMENT INDUCED BY CONSTRUCTION AND OPERATION OF THE SPRINGERVILLE GENERATING STATION[1/]

	Project Year														
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Total Employees	0	0	10	120	250	310	230	400	460	340	550	570	480	320	320
Movers and Travelers	0	0	5	70	150	185	140	250	290	220	350	360	320	220	220

1/ Ibid., p. 6.75, Table 6.2-18.

In addition to the Springerville-Eagar area, St. Johns, Holbrook, and Show Low will experience some increase in population attributable to the generating station. The expected population due to both the direct and indirect employment is projected as shown in Table 2-13. Note that total population increase due to the plant is highest in 1989 and 1990 and tapers off as construction draws to completion and only the operating personnel remain. The total project-related population in Springerville-Eagar and St. Johns will range from 20-27 percent of the indigenous population during the peak construction period.

COUNTY PROFILES

The NACOG report for Region III provides an excellent summary of expected trends in each of the three Arizona counties in the Little Colorado River Basin. County Profiles published by the New Mexico Interstate Stream Commission and the New Mexico State Engineer's Office provide an economic summary of the New Mexico counties. Extensive excerpts from those reports follow.

APACHE COUNTY, ARIZONA 1/

The most significant factor affecting Apache County's economic future, at least until 1987, is the construction of the two generating stations. As discussed previously, the impacts of the SRP Coronado Plant are significant, particularly in the areas of construction, trade and services, and real estate. These economic sectors will maintain a high level of activity although the focus will shift to the Round Valley (Springerville-Eagar) area. As construction on the plants is completed, there will be an influx of operators who will settle as a permanent part of the population. This is reflected in the numeric projections as an increase in the Transportation, Communications and Public Utilities (TCPU) sector employment.

There is also construction associated with the power plant projects which is being centered out of the community of Navajo on I-40. A spur rail line is being built to deliver coal to the generating plants. This is contributing to some growth along the I-40 corridor and this trend should continue.

Although the power plants stand out, other factors will generate growth in the county. Tourism, especially in the extreme southern part of the county, will become more important. Alpine and Greer will feel the brunt of this but spin-off benefits will result simply from a growing state population and this same factor should generate increased second home construction.

1/ This section is quoted verbatim from NACOG publication, "Existing and Projected Population, Land Use, and Economic Activity," Northern Arizona Council of Governments, Flagstaff, Arizona, March 7, 1978, pages 15, 16.

TABLE 2-13

POPULATION RESULTING FROM DIRECT PLUS INDIRECT EMPLOYMENT[1/]

Location	Project Year														
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Apache County															
Eagar	5	45	65	310	530	560	400	630	680	490	750	760	610	400	400
Springerville	5	50	70	320	560	570	390	630	660	450	710	720	570	350	350
St. Johns	10	60	90	440	760	790	530	850	900	630	970	980	770	480	480
Total	20	155	225	1070	1850	1920	1320	2110	2240	1570	2430	2460	1950	1230	1230
Navajo County															
Holbrook	0	0	0	10	30	35	25	50	65	50	75	80	70	50	50
Show Low	0	5	5	40	70	75	40	75	80	45	85	85	65	35	35
Total	0	5	5	50	100	110	65	125	145	95	160	165	135	85	85
Area Total	20	160	230	1120	1950	2030	1385	2235	2385	1665	2590	2625	2085	1315	1315

1/ Ibid., p. 6-80, Table 6.2-20.

Manufacturing should remain generally oriented around forest products with any changes occurring in the finished nature of the product produced. Manufacturing firms which utilize raw lumber to make finished products may be enticed into the area. The opportunity for this would be increased if bulk transportation services could be improved.

Agriculture will not grow in importance in Apache County, in fact it may experience a slight decline, but because of its role as a life style it will remain a factor. Given the right circumstances, it could again grow to a position of economic importance.

Apache County in general however, will experience rather steady growth. Public land policy will continue as an important economic factor, but as the economy diversifies it will become relatively less important.

COCONINO COUNTY, ARIZONA 1/

The continuing expansion of Flagstaff as a regional center will ensure a relatively high rate of growth for Coconino County. In general, all economic sectors except agriculture are projected to experience some growth, and indications are that this will be well spread out over the county although Flagstaff will continue to receive the most balanced development.

Government employment will continue to dominate in the Flagstaff area for the forseeable future. NAU enrollment will increase and this will generate more employment at the University. As the communities and the county continue to grow, local government employment will increase roughly in proportion. Federal employment will increase, but at a slow pace.

The trade and services sector will continue to be important in Coconino County. One new shopping center is under construction in Flagstaff and another large one is planned. One obvious benefit of this development should be to slow the flow of northern Arizona shoppers to Phoenix by providing a greater selection in Flagstaff. This will become much easier as the region grows.

If the flow of tourists and travelers continues to increase, this will ensure increasing trade and service activity countywide. Should this trend decline, Williams, 2/ and Grand Canyon 2/ area, and Flagstaff will probably feel the brunt, but the entire county will be impacted. Again energy costs and other national economic trends will be the telling factors. In general, however, the projection is for a continuing increase in trade and services activity.

1/ Ibid., pages 16. 17.

2/ Williams, Fredonia and Sedona are outside the Little Colorado River Basin. Also most of the Grand Canyon lies outside the Basin.

Manufacturing should increase in relative importance and diversity especially in the Flagstaff and Williams area. Transportation, energy considerations and natural amenities should all contribute to this growth. Fredonia 1/ will continue to be important as a forest products manufacturing center, but considering national trends toward more conservative timber harvesting practices, growth will be slow. Sedona 1/ will continue to specialize in arts and crafts type manufacturing.

Transportation, Communications and Public Utilities (TCPU) should become increasingly important especially in Flagstaff and Williams. Development and growth in this sector will be roughly in proportion to increase in population. An obvious exception to this would be if a special project such as a new power plant were developed. Barring discovery and development of new resources, mining should not grow significantly as an economic activity, although spinoff effects from other mining areas may increase. Agriculture will not grow either and, barring drastic changes in either government policy or consumer demand for beef, may decline slightly.

Construction activity should grow in importance in response to housing demand and commercial development. Shopping center construction in Flagstaff has already been mentioned and in addition several road construction projects are planned. Again, there is always the possibility that a major project may be undertaken and generate an increase in construction employment.

In general, Coconino county will experience solid growth in nearly every sector and will probably lead the region in the trend to economic diversification. Flagstaff will expand its role as the regional center but other areas will grow as well.

NAVAJO COUNTY, ARIZONA 2/

Navajo County has a relatively well rounded economy and the future will see growth in all sectors. Construction, TCPU* and trade and services should continue to prosper along the I-40 corridor while manufacturing will increase in importance. Tourism and second home development will continue in Pinetop/Lakeside area and Show Low will reinforce its position as the regional center for southern Navajo and Apache Counties.

The manufacturing sector in southern Navajo county will continue to prosper and should experience some diversification. Agriculture may

1/ See footnote 2 previous page.

2/ Ibid., pages 17, 18.

*Transportation, Communications and Public Utilities.

experience some limited growth especially in the Snowflake-Taylor area based upon the current importance of the hog industry.

The Heber-Overgaard area will experience continued growth based upon recreation development although no new basic economic activities are projected for that area.

Construction should prosper over all of Navajo county simply based upon increased population growth and its attendant housing demand.

Central Navajo County, as mentioned previously, is highly dependent upon auto-borne travelers and shoppers for its substantial trade and service economy. A reasonable prediction of the impact of higher gasoline prices cannot be made, but the potential impact of a decrease in personal discretionary travel must be noted. The existence of the railroads should become increasingly important as time goes on.

In general, the present rounded nature of Navajo county's economy will work to ensure balanced growth, and the indications are that Navajo County will increase its share of the regional prosperity.

CATRON COUNTY, NEW MEXICO 1/

Agriculture is Catron County's most important economic sector with cattle raising the dominant economic activity. This sector in 1970 accounted directly for over one-third of the county's employment and personal income and indirectly for most of the remainder.

In 1969, the market value of all agriculture products sold amounted to about $4,170,000 of which $4,150,000 was for livestock sales. The total sales of crops amounted to about $20,000. Most of the crop sales were for livestock feed or forage; thus, the agricultural sector is essentially oriented to livestock.

The second most important economic activity in Catron County is government. In 1970, the government sector accounted for about one-third of the employment in the county. The service sector is the third in economic importance, accounting for one-sixth of the employment. The remaining one-sixth of the employment occurs in wholesale and retail trade, transportation and public utilities, and miscellaneous.

During the 1960's, agriculture employment declined over one-third while government employment increased over forty percent. However, gains in employment in the nonagricultural sector have not been large enough to offset the losses in agriculture employment. As a result, the unemployed persons in the county have had to seek work elsewhere. This economic decline has caused an out-migration of about 200 workers

1/ The material in this section was taken directly from "County Profiles in Catron County-Water Resources Assessment for Planning Purposes," New Mexico Interstate Stream Commission and New Mexico State Engineer's Office, 1975.

from the work force during the 1960-70 period. This out migration has resulted in a 21 percent reduction in the population between 1960 and 1970.

Catron County was organized from part of Socorro County in 1921; thus, the first official census was not taken until 1930. The population reached a peak of 4,881 persons in 1940 and has declined since that time. The 1970 population of 2,198 is less than one-half the 1940 peak.

The prosperity of the county is directly related to the production and selling of beef cattle. Because of this narrow economic base, the levels of income and employment fluctuate widely.

In 1970, there were only two manufacturing firms in the county, both of which produced lumber and wood products.

Employment in 1970 was as follows: civilian work force - 810, unemployed - 45, percentage unemployment rate - 5.6, ranks 16th in the state in rate of unemployment.

MCKINLEY COUNTY, NEW MEXICO 1/

Significant changes in McKinley County's economic structure occurred during the 60's and they are particularly evident by examining the employment statistics. In this period, total employment in three sectors, agriculture, mining and construction decreased from the employment of one-third of the total number of workers to only one-fifth. These activities, which constituted the traditional economic base of the county, have generated a declining number of employment opportunities. Counter-balancing this trend has been a rapid growth in such sectors as government, trade, and services.

The most important economic activity in McKinley County is government spending, which accounts for about one-third of the personal income and employment. About two-thirds of the county's public activity is federal, while the remaining one-third is state or local. A large proportion of federal spending is accounted for by the Bureau of Indian Affairs and the U.S. Public Health Service.

The second most important economic sector is trade. The position of Gallup as the center of commerce in western New Mexico has produced a large number of trade establishments. In 1967, McKinley County had 341 retail trade establishments with a total sales of $59 million.

1/ The material in this section was taken directly from "County Profile-McKinley County-Water Resources Assessment for Planning Purposes," New Mexico Interstate Stream Commission and the New Mexico State Engineer Office, 1975.

The county's 48 wholesale trade establishments in 1967 registered total sales of about $40 million. Gallup's importance as a commercial center is evidenced by the fact it accounted for about 85 percent of the total retail sales (in McKinley County) and about 80 percent of the wholesale volume.

The third most important economic sector is services. This sector accounted for about 15 percent of the total employment in the county. Most of the service establishments are located in Gallup. A 1967 survey listed 149 service establishments in McKinley County of which only 17 were located outside of Gallup. The total receipts of these firms amounted to about $6.8 million, of which Gallup accounted for $6.3 million, or 95 percent of the county's total. A large proportion of these establishments provide services primarily to tourism and other travelers. For example, in 1967 there were 40 lodging places and 39 automotive or other repair firms. Similarly, nearly half of McKinley County's retail trade establishments were either gasoline service stations or restaurants. Many other Gallup retail firms, such as curio shops and Indian trading posts, also cater primarily to tourists.

The population of McKinley County has increased during each of the past six decades. Between 1910 and 1970, the total number of residents rose by over 233 percent. This increase has been larger than that of the state which was only 210 percent for this same period. McKinley County's population of 43,208 is exceeded by only 6 of the state's 32 counties. Thus, the county has a relatively large number of residents in comparison with most of the state's counties. The population of McKinley County is not concentrated in one urban area as it is in many counties of the state. This county is one of the few counties in which the rural population exceeds the urban population. Rural population amounts to fifty seven percent of the total population, and the majority of these rural people are Indians.

In New Mexico, only McKinley County has a majority of Indians. In 1970, over 62 percent of the total population was reported to be Indian, compared with about 7 percent in the state as a whole. McKinley County's Indian population lives primarily on the Navajo Reservation in the northwestern quadrant of the county, or the Zuni Reservation about 30 miles south of Gallup.

The categories of manufacturing firms in 1970 in McKinley County are listed below.

Total of 27 manufacturing firms: 6 - food and kindred products; 4 - lumber and wood products; 3 - printing, publishing and allied industries; 2 - chemicals and allied products; 1 - petroleum refining and related industries; 1 - rubber and miscellaneous plastic products; 1 - leather and leather products; 2 - stone, clay and glass products; 2 - fabricated metal products; 1 - machinery; 2 - electrical machinery, equipment and supplies; 2 - miscellaneous manufacturing industries.

Employment in 1970 was as follows: civilian work force - 14,909, unemployed - 952, percentage unemployment rate - 6.4, ranks 13th in state in rate of unemployment.

VALENCIA COUNTY, NEW MEXICO 1/

The two most important external factors which have influenced the economy of Valencia County have been uranium and the Albuquerque 2/ metropolitan area. The discovery and exploitation of uranium reserves were the primary causes of the county's rapid economic growth during the 1950's. Conversely, the county's economic difficulties during the 1960's derived almost entirely from reductions in uranium production. The economy in the eastern portion of the county is influenced by the Albuquerque metropolitan area and is less subjected to the rapid changes experienced by the mining economy of the Grants-Milan 2/ area.

Employment in Valencia County has fluctuated widely largely because of the ups and downs of the uranium mining industry. The unemployment rate in this county during the 1960's ranged from a low of 4.4 percent in 1969 to a high of 9.2 percent in 1964. The economy of Valencia County fluctuates in response to changes in the uranium industry, about 25 percent of all personal income is derived directly from mining.

The severe decline of agricultural employment during the 1950's in Valencia County was counterbalanced by a huge increase in mining employment. The uranium boom near Grants resulted in rapid increases of trade, services, and government employment.

The Belen and Los Lunas 2/ areas are insulated somewhat from the erratic, unpredictable mining-based economy in the Grants area. Therefore, economic changes in the Belen and Los Lunas areas have been more gradual. Employment opportunities in Albuquerque and the railroad shops at Belen are as important to the economy of the eastern portion of the county as mining is to the economy of the Grants area. Many residents of Los Lunas and Belen commute to Albuquerque for employment.

The categories of manufacturing firms in Valencia County in 1970 are listed below:

Total of 17 manufacturing firms: 3 - food and kindred products; 5 - lumber and wood products, except furniture; 2 - printing, publishing, and allied industries; 1 - chemicals and allied products; 1 - stone, clay and glass products; 3 - machinery, except electrical; 2 - electrical machinery, equipment and supplies.

1/ The material in this section was taken directly from "County Profile-Valencia County - Water Resources Assessment for Planning Purposes," New Mexico State Engineer's Office, 1975.

2/ Albuquerque, Grants, Milan, Belen and Los Lunas are outside the Little Colorado River Basin.

Employment in 1970 was as follows: civilian work force - 8,643, unemployed - 551, percentage unemployment rate - 6.4, ranks 14th in state in rate of unemployment.

EMPLOYMENT TRENDS

There has been a large reduction in agricultural employment in all Arizona counties since 1940. At the same time there have been large increases in service and retail trade employment due to new jobs created in business serving the tourist trade. These two categories of employment will continue to rise unless gasoline prices have a significant dampening effect on tourism.

Navajo and Apache Counties are very sensitive to changes in woodland management or the demand for wood products. Seventy percent of their manufacturing employment is in forest products. Coconino County is more diversified in types of manufacturing, but 50 percent of its employment is in forest products.

Agriculture is the most important economic sector in Catron County, New Mexico, with cattle raising the dominant economic activity. In 1970 agriculture accounted directly for over one-third of the county's employment and personal income and indirectly for most of the remainder. Government is the second largest employer in Catron County.

In McKinley County, New Mexico government accounts for the largest single block of employment and income--about one-third. Retail trade and services are second and third in number of employees respectively.

In Valencia County uranium mining and the Albuquerque metropolitan area have considerable impact on the economy. The ups and downs of the uranium industry caused large employment and population fluctuations in the 1950's and 1960's. The nearness of Albuquerque has a stabilizing influence on Valencia County especially the eastern portion.

Tables 2-14, 2-15 and 2-16 present historical employment by county for nine major economic sectors of the three Arizona counties. Data is for 1975, 1976, and 1977 and 1978 for whole counties. No attempt was made to differentiate employment inside the Little Colorado Basin from that outside. However, crude estimates could be made by applying whole county population to employment ratios to the population estimated to be inside the Basin.

Employment projections were not available for the New Mexico counties, however, numbers are shown by sector for 1975, 1976, 1977 and 1978 (Tables 2-17, 2-18, and 2-19). Catron County has very few firms in some sectors and numbers could not be shown due to disclosure rules.

Catron's manufacturing employment has increased slightly since 1970, while most other sectors have remained fairly stable except for services.

McKinley's mining employment more than doubled between 1970 and 1978 while manufacturing doubled between 1970 and 1975 and has remained fairly stable in recent years. Service employment also doubled from 1970 to 1978 in McKinley County.

TABLE 2-14

EMPLOYMENT BY SECTOR, APACHE COUNTY, ARIZONA
(COUNTYWIDE DATA)

Sector	1975	1976	1977	1978
Agriculture	235	240	215	220
Mining	75	60	50	50
Construction	725	715	975	1,675
Manufacturing	1,100	2,080	3,750	2,475
TCPU 1/	575	1,020	1,225	1,000
Trade	950	1,000	875	950
FIRE 2/	150	115	200	175
Services	2,800	3,780	3,475	4,175
Government	4,350	4,670	4,900	4,625
Other 3/	450	500	525	500
TOTAL 4/	11,190	12,935	13,835	13,830

1/Transportation, Communication and Public Utilities.

2/Finance, Insurance, and Real Estate.

3/Self-employed, unpaid family workers and domestics.

4/Total figures may not equal the addition of individual employment categories due to adjustment for commuting, multiple job holding, and conformity to the current population survey.

Source: Arizona Statistical Abstract, 1979.

TABLE 2-15

EMPLOYMENT BY SECTOR, COCONINO COUNTY, ARIZONA

(COUNTYWIDE DATA)

Sector	1975	1976	1977	1978
Agriculture	255	275	325	400
Mining	25	35	56	50
Construction	2,200	1,180	1,150	1,900
Manufacturing	1,600	1,660	2,000	2,000
TCPU 1/	1,375	1,585	1,650	1,700
Trade	4,750	4,940	5,425	5,825
FIRE 2/	450	505	500	500
Services	4,225	5,700	6,025	6,275
Government	7,375	8,130	8,375	9,275
Other 3/	1,045	1,100	1,150	1,200
TOTAL 4/	25,600	26,035	27,335	28,240

1/Transportation, Communication and Public Utilites.

2/Finance, Insurance and Real Estate.

3/Self employed, unpaid family workers and domestics.

4/Total figures do not equal the addition of individual employment categories due to adjustment for commuting, multiple job holding, and conformity to the current population survey.

Source: Arizona Statistical Abstract, 1979.

TABLE 2-16

EMPLOYMENT BY SECTOR, NAVAJO COUNTY, ARIZONA
(COUNTYWIDE DATA)

Sector	1975	1976	1977	1978
Agriculture	215	200	185	180
Mining	400	625	750	950
Construction 1/				
Manufacturing 1/	1,975	2,210	3,025	3,225
TCPU 2/	1,550	1,160	1,325	1,425
Trade	2,125	2,555	2,800	2,900
FIRE 3/	225	275	250	275
Services	3,225	4,145	4,675	4,125
Government	3,725	3,195	3,400	3,725
Other 4/	1,625	1,700	1,900	2,095
TOTAL 5/	10,093	10,806	13,067	17,151

1/Construction and manufacturing employment combined to avoid disclosure of information.

2/Transportation, Communication and Public Utilities.

3/Finance, Insurance and Real Estate.

4/Self-employed, unpaid family workers and domestics.

5/Total figures do not equal the addition of individual employment categories due to adjustment for commuting, multiple job holding, and conformity to the current population survey.

Source: Arizona Statistical Abstract, 1979.

TABLE 2-17

EMPLOYMENT BY SECTOR, CATRON COUNTY, NEW MEXICO
(COUNTYWIDE DATA)

Sector	1975	1976	1977	1978
Agriculture 1/	157	207	203	175
Mining	*	*	*	*
Construction	*	*	*	11
Manufacturing	92	108	115	144
TCPU 2/	14	12	*	*
Trade	29	38	32	33
FIRE 3/	*	0	*	*
Services	37	62	122	51
Government	314	314	287	306
TOTAL	872	962	1,010	1,021

1/Agriculture employment is for the month of March; average annual figures not available.

2/Transportation, Communications and Public Utilities.

3/Finance, Insurance and Real Estate.

*Disclosure problem.

Source: Employment Security Commission of New Mexico, Employment Services Division, Research and Statistics Section.

TABLE 2-18

EMPLOYMENT BY SECTOR, MCKINLEY COUNTY, NEW MEXICO
(COUNTYWIDE DATA)

Sector	1975	1976	1977	1978
Agriculture 1/	96	126	124	107
Mining	2,572	3,558	4,380	5,126
Construction	721	850	762	1,046
Manufacturing	1,209	1,222	1,147	1,059
TCPU 2/	994	1,062	1,067	1,036
Trade	3,553	3,822	3,725	3,942
FIRE 3/	359	328	335	350
Service	2,081	2,084	3,246	4,429
Government	4,415	4,506	4,541	4,599
TOTAL	16,000	17,558	19,327	21,694

1/Agriculture employment is for the month of March; average annual figures not available.

2/Transportation, Communications and Public Utilities.

3/Finance, Insurance and Real Estate.

Source: Employment Security Commission of New Mexico, Employment Services Division, Research and Statistics Section.

TABLE 2-19

EMPLOYMENT BY SECTOR, VALENCIA COUNTY, NEW MEXICO
1975-1978

(COUNTYWIDE DATA)

EMPLOYMENT BY SECTOR	1975	1976	1977	1978
Agriculture 1/	517	682	670	625
Mining	1,448	1,895	2,344	2,566
Construction	551	525	677	938
Manufacturing	275	302	270	291
TCPU 2/	888	907	881	950
Trade	1,897	2,064	2,272	2,478
FIRE 3/	404	413	431	483
Services	948	1,052	1,179	1,332
Government	2,479	2,483	2,620	2,870
TOTAL	9,407	10,323	11,344	12,533

1/Agriculture employment is for the month of March; average annual figures not available.

2/Transportation, Communication and Public Utilities.

3/Finance, Insurance and Real Estate.

Source: Employment Security Commission of New Mexico, Employment Services Division, Research and Statistics Section.

Both McKinley and Valencia had very large increases in employment in mining and construction. Valencia had almost 3 times the number employed in these two sectors in 1978 compared to 1970. Trade and finance employment doubled in Valencia in that period while both the services and the government sectors increased by a factor of about 1.5. Both McKinley and Valencia Counties had 1.7 times as many people employed in 1978 as in 1970.

Tables 2-20 through 2-25 show the labor force, total employment, total unemployment and unemployment rate for all six counties having population inside the Little Colorado River Basin.

Apache County's unemployment rate rose from 5.9 in 1971 to 11.4 in 1978 while total employed went from 7,975 to 12,235. Coconino County (where Flagstaff is located) gained 2 percentage points in unemployment over the period 1970 - 1978 while Navajo County gained almost 5 points.

All three New Mexico Counties had a net decrease in unemployment from 1970 to 1978. However, Catron's unemployment rose between 1972 and 1976 reaching a peak of 17 percent in 1975. Its overall rate was down from 8.7 in 1970 to 4.3 in 1978. McKinley declined from 8.5 to 5.9 percent and Valencia from 6.8 to 5.7 between 1970 and 1978.

Employment projections by sector are included for Arizona counties having land within the Basin (Table 2-26 thorugh 2-28). Comparable data for New Mexico counties having land within the Basin was not available at the time this report was completed.

INCOME

As was the case with employment, no attempt was made to estimate income data for the Basin portion of counties. Income is reported by whole county in Table 2-29 and 2-30. Per capita personal income and total income from the Regional Economics Information System are shown for 1972-1976 for all six counties. Valencia and Coconino (Flagstaff) Counties had the highest per capita personal income in 1976. In terms of per capita income the counties rank as follows:

Valencia	$ 4,673
Coconino	4,312
Navajo	3,908
Catron	3,892
McKinley	3,793
Apache	3,156

In terms of their 1976 total personal income the counties' rank is as follows:

County	Total Income
Coconino	$293,612,000
Navajo	239,216,000
Valencia	226,201,000
McKinley	212,253,000
Apache	138,205,000
Catron	9,170,000

TABLE 2-20

LABOR FORCE, EMPLOYMENT AND UNEMPLOYMENT
IN APACHE COUNTY, ARIZONA
1973-1978

(COUNTYWIDE DATA)

Year	Labor Force	Total Employed	Total Unemployed	Unemployment Rate
1973	8,625	7,925	700	8.1
1974	9,725	8,900	825	8.4
1975	11,190	9,755	1,435	12.8
1976	12,935	11,270	1,665	12.9
1977	13,835	11,940	1,895	13.9
1978	13,830	12,235	1,580	11.4

Source: Arizona Statistical Abstract, 1979

TABLE 2-21

LABOR FORCE, EMPLOYMENT AND UNEMPLOYMENT
IN COCONINO COUNTY, ARIZONA
1973-1978

(COUNTYWIDE DATA)

Year	Labor Force	Total Employed	Total Unemployed	Unemployment Rate
1973	22,675	21,550	1,125	5.0
1974	22,900	21,475	1,425	6.2
1975	25,600	23,300	2,300	9.0
1976	26,035	23,815	2,220	8.5
1977	27,335	25,150	2,185	8.0
1978	28,240	26,285	1,955	6.9

Source: Arizona Statistical Abstract, 1979.

TABLE 2-22

LABOR FORCE, EMPLOYMENT AND UNEMPLOYMENT
IN NAVAJO COUNTY, ARIZONA
1973-1978

(COUNTYWIDE DATA)

Year	Labor Force	Total Employed	Total Unemployed	Unemployment Rate
1973	15,275	14,225	1,050	6.9
1974	16,050	14,975	1,075	6.7
1975	18,405	16,195	2,210	12.0
1976	19,085	16,950	2,135	11.2
1977	21,940	19,380	2,560	11.7
1978	21,005	18,900	2,105	10.0

Source: Arizona Statistical Abstract, 1979.

TABLE 2-23

LABOR FORCE, EMPLOYMENT AND UNEMPLOYMENT
IN CATRON COUNTY, NEW MEXICO
1973-1978

(COUNTYWIDE DATA)

Year	Labor Force	Total Employed	Total Unemployed	Unemployment Rate
1973	944	844	100	10.6
1974	938	846	92	9.8
1975	1,050	872	178	17.0
1976	1,091	963	128	11.7
1977	1,088	1,010	78	7.2
1978	1,067	1,021	46	4.3

Source: Employment Security Commission of New Mexico, Employment Services Division, Research and Statistics Section

TABLE 2-24

LABOR FORCE, EMPLOYMENT AND UNEMPLOYMENT
IN MCKINLEY COUNTY, NEW MEXICO
1973-1978

(COUNTYWIDE DATA)

Year	Labor Force	Total Employed	Total Unemployed	Unemployment Rate
1973	13,533	12,492	1,041	7.7
1974	13,899	12,886	1,003	7.2
1975	14,891	13,792	1,099	7.4
1976	16,634	15,362	1,272	7.6
1977	18,705	17,402	1,303	7.0
1978	20,251	19,058	1,193	5.9

Source: Employment Security Commission of New Mexico, Employment Services Division, Research and Statistics Section.

TABLE 2-25

LABOR FORCE, EMPLOYMENT AND UNEMPLOYMENT
IN VALENCIA COUNTY, NEW MEXICO
1973-1978

(COUNTYWIDE DATA)

Year	Labor Force	Total Employed	Total Unemployed	Unemployment Rate
1973	14,608	13,434	1,174	8.0
1974	15,357	14,002	1,355	8.8
1975	17,072	15,434	1,638	9.6
1976	18,427	16,808	1,619	8.8
1977	20,780	19,246	1,534	7.4
1978	22,582	21,296	1,286	5.7

Source: Employment Security Commission of New Mexico, Employment Services Division, Research and Statistics Section.

TABLE 2-26

EMPLOYMENT PROJECTIONS BY SECTOR,
APACHE COUNTY, ARIZONA
1980-2000

(COUNTYWIDE DATA)

EMPLOYMENT BY SECTOR	1980	1985	1990	1995	2000
Agriculture	161	148	146	145	140
Mining	80	90	100	100	100
Construction	586	735	664	348	352
Manufacturing	953	1,142	1,262	1,391	1,534
TCPU (1)	804	981	1,071	1,156	1,222
Trade	1,186	1,470	1,754	2,030	2,383
FIRE (2)	178	212	244	272	305
Services	4,536	5,352	6,432	7,249	8,182
Federal Civilian[1/]	2,982	3,280	3,599	3,933	4,304
Federal Military	50	50	50	50	50
State/Local	2,165	2,679	3,194	3,548	4,220
Non-Ag. Proprietors	565	667	762	828	910
Total Employment	14,246	16,806	19,278	21,150	23,702

Source: Existing and Projected Population, Land Use and Economic Activity, NACOG Study, 1978.

(1) TCPU - Transportation, Communication, Public Utilities
(2) FIRE - Finance, Insurance, Real Estate

[1/] Some reviewers of this report judged this projection of federal civilian employment to be too high.

TABLE 2-27

EMPLOYMENT PROJECTIONS BY SECTOR,
COCONINO COUNTY, ARIZONA
1976-2000

(COUNTYWIDE DATA)

EMPLOYMENT BY SECTOR	1976	1980	1985	1990	1995	2000
Agriculture	200	161	148	146	145	140
Mining	25	29	39	46	53	61
Construction	1,675	1,458	1,898	2,330	2,910	3,520
Manufacturing	1,686	2,071	2,553	3,082	3,711	4,457
TCPU (1)	1,394	1,598	1,753	1,878	2,000	2,116
Trade	5,142	6,012	7,683	9,338	11,099	12,933
FIRE (2)	464	550	683	798	912	1,024
Services	4,811	5,712	7,470	8,839	10,364	12,073
Federal Civilian[1/]	2,649	3,072	3,724	4,479	5,373	6,222
Federal Military	200	200	200	200	200	200
State/Local	5,143	5,903	7,300	8,677	10,170	11,740
Non-Ag. Proprietors	1,958	2,304	2,866	3,363	3,904	4,488
Total Employment	25,347	29,070	36,317	43,176	50,841	58,974
Basic Employment	11,660	13,421	16,960	20,455	24,682	29,425
NACOG Employment	69,076	80,581	96,519	111,959	127,683	145,822
Total Income (3)	232,021	291,713	406,348	532,633	681,531	855,367

Source: Existing and Projected Population, Land Use and Economic Activities, NACOG Study, 1978.

(1) TCPU - Transportation Communication, Public Utilities
(2) FIRE - Finance, Insurance, Real Estate

[1/] Some reviewers of this report judged this projection of federal civilian employment to be too high.

TABLE 2-28

EMPLOYMENT PROJECTIONS BY SECTOR,
NAVAJO COUNTY, ARIZONA
1976-2000

(COUNTYWIDE DATA)

EMPLOYMENT BY SECTOR	1976	1980	1985	1990	1995	2000
Agriculture	225	181	167	167	167	167
Mining	575	686	890	890	890	890
Construction	945	944	1,085	1,217	1,366	1,543
Manufacturing	1,073	1,245	1,510	1,776	2,085	2,450
TCPU (1)	1,646	1,937	2,247	2,446	2,664	2,912
Trade	2,133	2,617	3,316	3,927	4,551	5,288
FIRE (2)	248	295	359	414	472	538
Services	4,055	4,579	5,296	5,987	6,763	7,691
Federal Civilian[1/]	1,958	2,336	2,901	3,571	4,390	5,395
Federal Military	200	200	200	200	200	200
State/Local	1,774	2,224	2,865	3,469	4,147	4,951
Non-Ag. Proprietors	1,544	1,801	2,153	2,468	2,807	3,210
Total Employment	16,376	19,045	22,989	26,532	30,502	35,235

Source: Existing and Projected Population, Land Use and Economic Activity, NACOG Study, 1978

(1) TCPU - Transportation Communication, Public Utilities
(2) FIRE - Finance, Insurance, Real Estate

[1/] Some reviewers of this report judged this projection of federal civilian employment to be too high.

TABLE 2-29

PER CAPITA AND TOTAL PERSONAL INCOME BY COUNTY, ARIZONA COUNTIES

(COUNTYWIDE DATA)

Item	1972	1973	1974	1975	1976
	dollars				
Apache County					
Per Capita P.I.	2,533	2,586	2,731	2,962	3,156
Total County P.I.	92,633,000	101,815,000	108,116,000	124,462,000	138,205,000
Coconino County					
Per Capita P.I.	3,527	3,917	3,894	3,997	4,312
Total County P.I.	200,758,000	233,660,000	244,544,000	268,415,000	293,612,000
Navajo County					
Per Capita P.I.	2,757	2,975	3,159	3,605	3,908
Total County P.I.	143,898,000	159,599,000	178,893,000	212,368,000	239,216,000

Source: Regional Economics Information System, Bureau of Economic Analysis, U.S. Department of Commerce.

TABLE 2-30

PER CAPITA AND TOTAL PERSONAL INCOME BY COUNTY
NEW MEXICO COUNTIES

(COUNTYWIDE DATA)

Item	1972	1973	1974	1975	1976
	dollars				
Catron County					
Per Capita P.I.	2,606	2,919	3,332	3,414	3,892
Total County P.I.	5,973,000	6,894,000	8,139,000	8,058,000	9,170,000
McKinley County					
Per Capita P.I.	2,389	2,551	2,944	3,741	3,793
Total County P.I.	112,590,000	121,929,000	143,641,000	177,190,000	212,253,000
Valencia County					
Per Capita P.I.	2,785	3,015	3,400	4,024	4,673
Total County P.I.	117,117,000	131,125,000	150,230,000	185,633,000	226,201,000

Source: Regional Economics Information System, Bureau of Economic Analysis, U.S. Department of Commerce.

Total county personal income increased by a factor of 1.8 between 1971 and 1976 for all counties except Valencia. Valencia's factor of increase was 2.2.

Tables 2-31 through 2-36 show personal income by major industry from the Regional Economics Information System. As with the employment figures, the mining construction sectors show large gains in income from 1971-1976 in all counties except Coconino and Catron. Manufacturing income doubled in all counties except Catron and Valencia. Personal income from wholesale and retail trade sources doubled or almost doubled in McKinley and Valencia counties but did not do as well in other counties.

Table 2-37 shows projected income data for whole Arizona counties having land within the Little Colorado River Basin, 1980-2000. Figures were borrowed from the NACOG study entitled "Existing and Projected Population Land Use and Economic Activity." Over the twenty year period, income is projected to increase at an average annual rate of about 4% in Navajo County. Projections for Coconino County suggest an annual rate of growth of about 3%, while growth for Apache County is projected at a slightly lesser rate. Given that Coconino County has a considerably larger income base than either Navajo or Apache Counties, the greatest actual growth in income will occur in Coconino County.

Comparable income projections for New Mexico counties having land within the Basin were not available at the time this report was completed.

AGRICULTURE

CROPLAND 1/

According to the 1974 figures, there are approximately 133,250 acres of cropland in six of the seven counties of the Little Colorado River Basin (Table 2-38). About 47,710 acres of this cropland are irrigated. Of the total cropland, about 43,716 acres, or one third, is actually harvested. Another 48,863 acres were used primarily for pasture.

1/ The cropland data presented in this section is countywide data. Refer to Appendix II Water Resources, Section 1, "Irrigation" for cropland data within the Little Colorado River Basin.

TABLE 2-31

PERSONAL INCOME BY MAJOR INDUSTRY, APACHE COUNTY, ARIZONA
(COUNTYWIDE DATA)

Sector	1971	1972	1973	1974	1975	1976
	--- 1,000 Dollars ---					
Agriculture	L	D	L	L	D	D
Mining	D	531	870	901	1,281	1,309
Construction	D	D	D	D	7,678	14,505
Manufacturing	5,479	6,476	5,498	6,390	7,260	9,850
Utilities and Transportation	D	D	5,054	6,435	7,211	7,927
Trade	4,624	4,921	5,149	6,110	6,429	6,953
FIRE	947	1,027	1,243	1,054	432	D
Services	D	D	D	D	19,388	18,444
Government	27,784	31,220	34,542	40,549	45,117	50,087

L = Less than $50,000
D = Disclosure Problem

Source: Regional Economics Information System, Bureau of Economic Analysis, U.S. Department of Commerce

TABLE 2-32

PERSONAL INCOME BY MAJOR INDUSTRY, COCONINO COUNTY, ARIZONA
(COUNTYWIDE DATA)

Sector	1971	1972	1973	1974	1975	1976
	1,000 Dollars					
Agriculture	195	241	299	313	317	D
Mining	D	333	D	494	471	D
Construction	29,687	51,751	65,426	D	41,902	22,941
Manufacturing	10,332	12,663	14,381	16,445	16,976	19,702
Utilities and Transportation	D	D	13,853	14,775	21,800	28,945
Trade	3,267	3,585	4,145	4,510	4,659	5,214
FIRE	26,585	29,020	34,690	35,253	35,789	41,018
Services	21,935	D	D	D	33,138	37,569
Government	42,491	48,273	56,116	64,373	77,317	88,338
Other					232	

L = Less than $50,000
D = Disclosure Problem

Source: Regional Economics Information System, Bureau of Economic Analysis, U.S. Department of Commerce.

TABLE 2-33

PERSONAL INCOME BY MAJOR INDUSTRY, NAVAJO COUNTY, ARIZONA

(COUNTYWIDE DATA)

Sector	1971	1972	1973	1974	1975	1976
			--- 1,000 Dollars ---			
Agriculture	96	89	115	158	133	153
Mining	2,158	2,809	4,020	6,458	9,378	16,360
Construction	8,552	8,287	7,210	13,324	23,764	21,798
Manufacturing	9,151	9,239	11,212	13,538	15,069	17,473
Utilities and Transportation	14,611	15,807	17,261	17,846	18,792	21,312
Trade	14,039	14,934	16,803	17,894	18,769	21,636
FIRE	2,463	2,381	2,328	2,353	2,136	2,733
Services	13,455	15,142	15,266	15,869	16,303	18,358
Government	26,853	31,104	35,710	40,394	46,629	53,475

Source: Regional Economics Information System, Bureau of Economic Analysis, U.S. Department of Commerce

TABLE 2-34

PERSONAL INCOME BY MAJOR INDUSTRY, CATRON COUNTY, NEW MEXICO
(COUNTYWIDE DATA)

Sector	1971	1972	1973	1974	1975	1976
	--- 1,000 Dollars ---					
Agriculture	L	L	L	L	L	D
Mining	D	D	L	D	D	D
Construction	D	D	D	D	D	D
Manufacturing	854	1,072	1,116	1,061	860	1,087
Utilities and Transportation	122	173	D	241	D	D
Trade	203	271	273	313	341	443
FIRE				L		L
Services	95	135	174	D	L	D
Government	1,661	1,540	1,955	2,143	2,919	3,065

L = Less than $50,000
D = Disclosure Problem

Source: Regional Economics Information System, Bureau of Economic Analysis, U.S. Department of Commerce

TABLE 2-35

PERSONAL INCOME BY MAJOR INDUSTRY, McKINLEY COUNTY, NEW MEXICO
(COUNTYWIDE DATA)

Sector	1971	1972	1973	1974	1975	1976
			--- 1,000 Dollars ---			
Agriculture	61	79	92	99	94	135
Mining	21,470	20,073	17,669	26,264	42,397	66,870
Construction	3,796	4,231	5,239	6,438	10,965	13,239
Manufacturing	4,064	5,498	4,884	7,823	9,617	11,039
Utilities and Transportation	10,191	11,026	12,337	12,540	13,272	15,594
Trade	17,669	20,459	23,895	27,566	32,143	35,179
FIRE	1,695	2,229	2,429	2,753	3,296	3,475
Services	8,245	9,009	9,820	10,786	12,905	13,801
Government	30,572	35,825	38,462	42,738	50,258	54,867

Source: Regional Economics Information System, Bureau of Economic Analysis, U.S. Department of Commerce

TABLE 2-36

PERSONAL INCOME BY MAJOR INDUSTRY, VALENCIA COUNTY, NEW MEXICO
(COUNTYWIDE DATA)

Sector	1971	1972	1973	1974	1975	1976
			--- 1,000 Dollars ---			
Agriculture	178	206	227	261	220	245
Mining	6,839	8,322	9,911	13,343	20,686	33,010
Construction	3,067	4,184	6,131	4,724	7,282	7,311
Manufacturing	1,777	1,995	1,392	1,889	2,060	2,590
Utilities and Transportation	9,512	10,081	11,938	12,365	13,277	15,121
Trade	8,559	9,097	9,844	11,233	13,770	16,581
FIRE	2,205	2,989	3,398	3,709	3,877	4,034
Services	6,808	7,140	7,131	7,895	8,948	10,169
Government	12,692	14,301	15,283	16,306	18,996	20,193

Source: Regional Economics Information System, Bureau of Economic Analysis, U.S. Department of Commerce

TABLE 2-37

PROJECTED INCOME DATA FOR COUNTIES HAVING LAND
WITHIN THE LITTLE COLORADO RIVER BASIN
1975-2000 (1972)

(COUNTYWIDE DATA)

County	Unit	1975	1980	1985	1990	2000
Apache						
Total Income	Dollars (000)	109,249	115,998	193,700	246,102	364,295
Per Capita	Dollars	2,594	2,345	3,382	3,789	4,613
Coconino						
Total Income	Dollars (000)	232,021	291,713	406,348	532,633	855,367
Per Capita	Dollars	3,446	3,767	4,319	4,896	6,218
Navajo						
Total Income	Dollars (000)	181,160	233,096	313,066	397,620	629,348
Per Capita	Dollars	3,078	3,376	3,899	4,370	5,509
Total Income	Dollars (000)	522,430	640,807	913,114	1,176,355	1,849,010
Per Capita Income	Dollars	3,123	3,270	3,942	4,444	5,590

Source: Existing and Projected Population Land Use and Economic Activity, NACOG.

TABLE 2-38

AREAS OF CROPLAND IN COUNTIES HAVING
LAND WITHIN THE LITTLE COLORADO
RIVER BASIN, 1974

(COUNTYWIDE DATA)

County and State	Total Cropland	Cropland Harvested	Cropland used only for pasture
		Acres for all Farms	
Apache, Arizona	38,577	10,958	10,358
Coconino, Arizona	12,283	1,542	7,376
Navajo, Arizona	23,522	12,595	6,158
Arizona Total	74,382	25,095	23,892
Catron, New Mexico	8,752	918	7,067
McKinley, New Mexico	15,331	2,497	4,989
Valencia, New Mexico	34,785	15,206	12,915
New Mexico Total	58,868	18,621	24,971
Total	133,250	43,716	48,863
		Acres for Farms with Sales of $2,500 and over	
Apache, Arizona	11,910	4,190	6,184
Coconino, Arizona	7,038	445	6,333
Navajo, Arizona	9,367	3,982	3,784
Arizona Total	28,315	8,617	16,301
Catron, New Mexico	4,344	819	2,932
McKinley, New Mexico	4,234	381	3,212
Valencia, New Mexico	22,815	11,449	8,136
New Mexico Total	31,393	12,649	14,280
Total	59,708	21,266	30,581

1/Source: 1974 Census of Agriculture, Vol. 1, for the two states.

Apache County had the largest proportion of total cropland within the Basin in 1974 (38,577 acres). Approximately one quarter of this land was harvested; another quarter was used for pasture. Of the total cropland harvested, less than a third was from farms whose sales exceed $2,500.

Valencia County, with 34,785 acres of total cropland, had the greatest amount of cropland within the New Mexico portion of the Basin. Nearly one half of the available cropland was actually being harvested, while a sizeable portion was used as pasture. About two-thirds of the Valencia County farms, accounting for approximately three-fourths of the cropland harvested, had sales exceeding $2,500. Valencia had the highest proportion of farms with sales of $2,500 and over among the six Basin counties.

McKinley County had 15,331 total acres of cropland in 1974 of which only 2,497 were actually harvested. Another 4,989 was used for pasture. Of the total cropland harvested, only 381 were operated by farms whose sales exceeded $2,500.

Navajo County had 23,522 acres of available cropland, of which about half was harvested in 1974. This was the highest proportion of land harvested among the Basin counties. Approximately one-third of the cropland has farms whose sales exceeded $2,500.

Coconino County had 12,283 acres of cropland of which only one-eighth was harvested in 1974. Most of the cropland was on farms in the $2,500 and over sales bracket. A major portion of the cropland has been turned to pasture.

According to the 1974 Census of Agriculture, Valencia had the greatest amount of land irrigated of the Basin Counties with over 18,000 acres (Table 2-39). Apache County had 15,782 irrigated acres of land, while Navajo County had some 7,117 acres under irrigation. Irrigation use appears much less extensive in Coconino, Catron and McKinley Counties. Census of Agriculture estimates of water applied per acre irrigated ranged from a low of 2.1 acre-feet in Catron, New Mexico to a high of 2.8 acre feet in Valencia, New Mexico. 1/

AGRICULTURAL PRODUCTION

The agricultural data in the following tables were taken from the annual agricultural statistics reports published by the Arizona Crop and Livestock Reporting Service and the New Mexico Crop and Livesotck Reporting Service. It was not possible to break the data down from the county level to the Basin boundaries. Consultation with the Arizona Crop and Livestock Reporting Service revealed that the data gathering process is designed for a high degree of accuracy at the state level. Much accuracy is lost in breaking the data down to county level and any estimates below county level would be unreliable. For irrigated crops, the acreage of irrigated land within the Little Colorado River Basin can serve as a guide to overall production.

1/ Water Resources, Appendix II, Section 1, Irrigation gives more detail on present and expected future irrigation in various areas of the Little Colorado River Basin. Copies may be obtained from the State Office of the Soil Conservation Service, USDA, Phoenix. Arizona.

TABLE 2-39

ACRES IRRIGATED IN COUNTIES OF
THE LITTLE COLORADO RIVER BASIN, 1974 1/

(COUNTYWIDE DATA)

County and State	All Irrigated Farms	Irrigated Farms with Sales of $2,500 and over	
	Land Irrigated 2/	Land Irrigated	Harvested Cropland Irrigated
	(Acres)	(Acres)	(Acres)
Apache, Arizona	15,782	8,197	3,422
Coconino, Arizona	2,980	1,121	385
Navajo, Arizona	7,117	5,072	3,912
Arizona Total	25,879	14,390	7,719
Catron, New Mexico	1,879	1,706	574
McKinley, New Mexico	1,695	187	124
Valencia, New Mexico	18,257	13,242	11,245
New Mexico Total	21,831	15,135	11,943
Sum Total	47,710	29,525	19,662

1/ Source: 1974 Census of Agriculture, Vol. 1, for the two states.

2/ For projections of irrigated acreage within the Basin by "Water Use Area" see Little Colorado River Basin, Appendix II, Water Resources; Section 1: "Irrigation".

A recent report by NACOG described Northern Arizona Agriculture as follows:

> Agriculture has traditionally been an important economic component of northern Arizona. The emphasis was and still is on livestock and the growing of supporting feed crops such as hay, corn and barley. Because of the low productivity of much of the range land, the industry has relied on inexpensive leases of large tracts of public land to operate successfully. Drastically increased costs of doing business, low prices for cattle and changing emphasis of public land management agencies has made ranching an increasingly marginal operation for small owners. In addition, a series of bad water years have made things more difficult. Prices for hay and other feed crops have remained high so that farmers have been increasing production. The constraining variables here are water and growing season. Hog production is also becoming more important in Navajo County. 1/

Despite increased production costs and other factors which could be expected to have a considerable impact on agriculture in northern Arizona, cash receipts from crop and livestock have increased substantially in Apache and Coconino counties during the 1972-78 period. In Navajo County receipts from livestock almost doubled while receipts from crops dropped slightly (Table 2-40). Total receipts increased by 91 percent, 139 percent, and 47 percent in Apache, Coconino, and Navajo Counties respectively.

Cash receipts by county were not available for New Mexico Counties. Estimated value of production for the New Mexico Counties was $3.8 million in 1974 and almost $4 million in 1978 (Table 2-41). In 1977 Valencia County used 2,662 tons fertilizer compared to 559 for McKinley and zero for Catron.

Tables 2-42 through 2-50 show the total acreage planted by principal crop in each of the LCRB counties. Of the total acreage planted, only a portion is likely to be harvested in any given year. A number of factors, or combinations of factors, may account for the discrepancy in acreage planted and harvested. Crops may have initially been planted for pasture, or as 'green manure' to be plowed under. Sharply falling market prices may have reduced the profit margin to the point where farmers are no longer willing to harvest their crops. Finally, crop failure due to insects, pests, disease and/or severe weather conditions is often responsible for a considerable loss in acreage harvested.

Production of corn has fluctuated over the 1972-77 period, due in part to fluctuations within the livestock industry. Production was increased in Navajo County, while Coconino has seen a reduction in total acreage planted to corn. The production of wheat is limited to the eastern portion of the Basin. In Valencia County, New Mexico, wheat production increased from 18,000 bushels in 1975 to 116,000 bushels in 1977 but was back down again in 1978. Valencia County also produces vegetables such as lettuce and onions. Other forage crops grown within the Basin include hay, sorghum and barley.

1/ NACOG 208 Program, "Existing and Projected Population, Land Use and Economic Activity," Northern Arizona Council of Governments, Flagstaff, Arizona, March 18, 1978, p. 9. (Value of cattle increased to a high of $385.00/head in early 1979 as compared with $165.00/head in 1975, representing an increase of 133%.) Arizona Agricultural Statistics, Arizona Crop and Livestock Reporting Service.

TABLE 2-40

CASH RECEIPTS FROM FARM MARKETINGS IN CURRENT DOLLARS COMPARED TO 1977 DOLLARS FOR THREE ARIZONA COUNTIES 1/

(COUNTYWIDE DATA)

County	Year	Crop Receipts		Livestock Receipts		Total Crops and Livestock	
		Current Dollars	1977 Dollars	Current Dollars	1977 Dollars	Current Dollars	1977 Dollars
		1,000 dollars					
Apache	1972	2,255	3,937	8,806	11,386	11,061	15,323
	1973	2,490	2,781	14,068	13,477	16,558	16,258
	1974	6,384	4,768	6,953	7,370	13,337	12,138
	1975	4,883	3,858	7,431	7,542	12,314	11,400
	1976	6,503	5,413	6,303	6,253	12,806	11,666
	1977	5,981	6,257	8,130	8,130	14,111	14,387
	1978	11,470	11,332	22,284	18,072	33,754	29,404
Coconino	1972	3,332	5,818	8,365	10,816	11,697	16,634
	1973	3,640	4,066	13,766	13,188	17,406	17,254
	1974	10,618	7,932	5,818	6,167	16,436	14,099
	1975	9,468	7,480	9,024	9,159	18,492	16,639
	1976	10,459	8,723	9,577	9,500	20,036	18,223
	1977	9,330	9,330	11,138	11,138	20,468	20,468
	1978	20,361	16,513	28,707	23,281	49,068	39,794
Navajo	1972	2,354	4,110	7,700	9,956	10,054	14,066
	1973	2,814	3,143	11,699	11,208	14,513	14,351
	1974	3,182	2,377	8,707	9,229	11,889	11,606
	1975	3,008	2,376	13,131	13,328	16,139	15,704
	1976	3,644	3,039	12,767	12,665	16,411	15,704
	1977	6,504	6,504	15,180	15,180	21,684	21,684
	1978	4,119	3,341	21,462	17,406	25,581	20,747

1/ Cash receipts were not available for New Mexico Counties.

2/ Price index numbers used to convert current dollars to 1977 dollars:

Crop: 1972 - 1.746, 1973 - 1.117, 1974 - .747, 1975 - .790, 1976 - .834, 1977 - 1.0, 1978 - .988

Livestock: 1972 - 1.293, 1973 - .958, 1974 - 1.060, 1975 - 1.015, 1976 - .992, 1977 - 1.0, 1978 - .811

Source: Arizona Agricultural Statistics, the Arizona Crop and Livestock Reporting Service, USDA.

TABLE 2-41

VALUE OF PRODUCTION FOR SIX COUNTIES
HAVING LAND IN THE LITTLE COLORADO
RIVER BASIN, ARIZONA AND NEW MEXICO

(COUNTYWIDE DATA)

(DOLLARS)

CROP	APACHE		COCONINO		NAVAJO	
	1974	1978	1974	1978	1974	1978
Corn	185,000	144,720	111,000	104,520	265,600	519,643
Sorghum	85,760	113,220	-	-	64,900	225,490
Wheat	-	-	-	-	78,750	76,000
All Hay	688,800	720,000	257,600	279,000	890,000	1,124,550
Total Value	959,560	977,940	368,600	383,520	1,299,250	1,945,683

CROP	CATRON		MCKINLEY		VALENCIA	
	1974	1978	1974	1978	1974	1978
Barley	-	-	-	-	69,000	7,200
Corn	6,400	-	37,300	13,668	136,900	235,760
Sorghum	11,400	1,454	-	-	18,200	-
Wheat	1,700	-	3,400	62,000	57,800	62,320
All Hay	40,400	75,000	124,600	22,800	3,277,800	3,498,000
Total Value	59,900	76,454	165,300	98,468	3,559,700	3,803,280

TABLE 2-42

APACHE COUNTY ARIZONA CROP DATA
ACREAGE, YIELD, PRODUCTION AND VALUE

(COUNTYWIDE DATA)

Item	Unit	1974	1975	1976	1977	1978
Corn						
Total Acres	Ac	2,700/2,500 1/	2,700/2,500	3,000/2,500	3,500/3,000	3,000/2,000
Yield	Bu	20	20	15	14	27
Production	Bu	50,000	50,000	37,500	42,300	54,000
Value	Dollars	185,000	160,000	97,500	93,060	144,720
Sorghum						
Total Acres	Ac	500/400	600/400	600/-	700/400	600/600
Yield	Bu	63	62	-	70	74
Production	Bu	25,000	24,600	-	28,000	44,400
Value	Dollars	85,760	71,850		63,000	113,220
All Hay						
Acres Harvested	Ac	-/7,000	-/7,300	-/7,400	-/6,500	-/5,000
Yield	Ton	2.9	3.2	2.4	3.0	3.0
Production	Ton	12,300	15,900	16,500	14,700	12,000
Value		688,800	938,100	1,130,250	955,500	720,000
Price	Dollars	56.00	59.00	68.50	65.00	60.00

1/ Acres planted/acres harvested.

Source: Arizona Agricultural Statistics, the Arizona Crop and Livestock Reporting Service, USDA.

TABLE 2-43

COCONINO COUNTY ARIZONA CROP DATA
ACREAGE, YIELD AND PRODUCTION

(COUNTYWIDE DATA)

Item	Unit	1974	1975	1976	1977	1978
Corn						
Total Acres	Ac	1,500/1,200 1/	1,800/1,000	1,800/1,500	2,000/-	2,000/1,500
Yield	Bu	25	21	14	-	26
Production	Bu	30,000	21,000	20,900	-	39,000
Value	Dollars	111,000	67,200	54,340	-	104,520
All Hay						
Acres Harvested	Ac	1,600	1,700	1,800	1,800	1,600
Yield	Ton	2.88	2.71	2.72	2.72	2.91
Production	Bu	4,600	4,600	4,900	4,900	4,650
Value	Dollars	257,600	27,400	335,650	318,500	279,000
Price	Dollars	56.00	59.00	68.50	65.00	60.00

1/ Acres Planted/acres harvested

Source: Arizona Agricultural Statistics, the Arizona Crop and Livestock Reporting Service, USDA.

TABLE 2-44

NAVAJO COUNTY ARIZONA CROP DATA
ACREAGE, YIELD, PRODUCTION AND VALUE

(COUNTYWIDE DATA)

Item	Unit	1974	1975	1976	1977	1978
Corn						
Total Acres	Ac	6,500/3,000	6,200/4,000	6,800/6,400	8,000/7,500	6,000/4,000
Yield	Bu	24	21	14	15	52
Production	Bu	71,800	84,300	89,100	112,500	207,900
Value	Dollars	265,600	269,700	231,800	281,600	519,643
Sorghum						
Total Acres	Ac	1,600/500	1,600/500	1,600/500	2,500/900	2,500/2,300
Yield	Bu	38	35	37	38	38
Production	Bu	18,900	17,500	18,571	34,200	87,400
Value	Dollars	64,900	51,100	44,570	70,452	225,490
Wheat						
Total Acres	Ac	800/500	600/500	700/600	600/500	600/500
Yield	Bu	42	51	55	52	50
Production	Bu	21,000	25,700	33,000	26,000	25,000
Value	Dollars	78,750	81,470	129,030	69,680	76,000
All Hay						
Acres Harvested	Ac	5,700	5,900	6,100	6,500	7,100
Yield	Tons	2.8	2.6	3.0	3.1	2.7
Production	Tons	16,000	15,200	18,200	20,300	18,900
Value	Dollars	890,000	896,800	1,246,700	1,309,350	1,124,550

1/ Acres planted/acres harvested

Source: Arizona Agricultural Statistics, the Arizona Crop and Livestock Reporting Service, USDA.

TABLE 2-45

CATRON COUNTY NEW MEXICO CROP DATA
ACREAGE AND YIELD, 1/

(COUNTYWIDE DATA)

	Unit	1974	1975	1976	1977	1978
Barley						
Irrigated	A				30/0	40/0
Yield Irrigated	Bu					
Non Irrigated	A					
Yield Non-Irrig.	Bu					
Total Acres	A				30	40/0
Corn						
Irrigated	A	160/40 1/	60/0	90/80	70/0	120/0
Yield Irrigated	Bu	52.0		46.0		
Non Irrigated	A					
Yield Non Irrig.	Bu					
Total Acres	A	160	60	90	70	120/0
Sorghum						
Irrigated	A	50/50				10/10
Yield Irrigated	Bu	74.				57.0
Non Irrigated	A					
Yield Non Irrig.	Bu					
Total Acres	A	50/50				10/10
Wheat						
Irrigated	A	50/20	30/0	90/0	40/0	100/0
Yield Irrigated	Bu	21				
Non Irrigated	A	20/0	70/0	20/0	40/0	40/0
Yield Non Irrig.	Bu					
Total Acres	A	70/20	100	110	80	140/0
All Hay						
Acres	A	450	350	500	550	550
Yield	Ton	1.5	2.0	2.0	2.4	2.3

1/ No entry means nothing was planted.

Source: New Mexico Agricultural Statistics, The New Mexico Crop and Livestock Reporting Service, USDA.

TABLE 2-46

CATRON COUNTY, NEW MEXICO
CROP DATA, PRODUCTION AND VALUE 1/
(COUNTYWIDE DATA)

Item	Unit	1974	1975	1976	1977	1978
Barley						
Production	Bu					
Value	Dollars					
Corn						
Production	Bu	2,080 2/		3,680		
Value	Dollars	6,400		8,200		
Sorghum						
Production	Bu	3,700				570
Value	Dollars	11,400				
Wheat						
Production	Bu	420				
Value	Dollars	1,700				
Hay						
Production	Tons	690	750	1,050	1,310	1,250
Value	Dollars	40,400	40,500	66,700		

1/ Acres planted/acres harvested.

2/ No entry means either that nothing was planted or else that which was planted was not harvested.

Source: New Mexico Agricultural Statistics, The New Mexico Crop and Livestock Reporting Service, USDA.

TABLE 2-47

MCKINLEY COUNTY, NEW MEXICO CROP DATA
ACREAGE AND YIELD 1/

(COUNTYWIDE DATA)

Item	Units	1974	1975	1976	1977	1978
Barley						
Irrigated	Ac				10	
Yield Irrigated	Bu					
Non Irrigated	Ac		50	20		
Yield Non Irrig.	Bu					
Total Acres	Ac		50	20	10	
Corn						
Irrigated	Ac	200/150 2/	150/50	80/70	160/90	180/170
Yield Irrigated	Bu	27	25	25	30	30
Non Irrigated	Ac	300/0	600/430	600/250	210/170	100/0
Yield Non-Irrig.	Bu		10	8	15	-
Total Acres	Ac	500/150	750/480	680/320	370/260	280/170
Sorghum						
Irrigated	Ac				60/0	
Yield Irrigated	Bu					
Non Irrigated	Ac	150/0				
Yield Non Irrig.	Bu					
Total Acres	Ac	150				

Table 2-47--cont'd.

Wheat						
Irrigated	Ac		100/0	100/50	60/50	40/30
Yield Irrigated	Bu			19		
Non Irrigated	Ac	400/50	2,500/1,500	720/500	340/20	140/130
Yield Non Irrig.	Bu	17	9	9	4	12
Total Acres	Ac	400/50	2,600/1,500	820/500	400/70	180/160
All Hay						
Acres	Ac	1,450	1,000	1,250	650	350
Yield	Ton	1.50	1.40	1.13	1.31	1.09

1/ Acres planted/acres harvested.

2/ No entry means nothing was planted.

Source: New Mexico Agricultural Statistics, the New Mexico Crop and Livestock Reporting Service, USDA.

TABLE 2-48

MCKINLEY COUNTY, NEW MEXICO CROP DATA,
PRODUCTION AND VALUE 1/

(COUNTYWIDE DATA)

Item	Units	1974	1975	1976	1977	1978
Corn						
Production	Bu	12,150	5,550	3,750	5,250	5,100
Value	Dollar	37,300	14,500	8,400	10,500	
Wheat						
Production	Bu	850	13,500	4,950	80	2,040
Value	Dollars	3,400	47,500	14,400	200	62,000
Hay						
Production	Tons	2,130	1,400	1,410	850	380
Value	Dollars	124,600	75,600	89,500	48,875	22,800

1/ Acres planted/acres harvested.

Source: New Mexico Agriculture Statistics, the New Mexico Crop and Livestock Reporting Service, USDA.

TABLE 2-49

VALENCIA COUNTY, NEW MEXICO
CROP DATA, ACREAGE AND YIELD 1/

(COUNTYWIDE DATA)

Item	Unit	1974	1975	1976	1977	1978
Barley						
Irrigated	Ac	1,300/900 2/	900/450	130/100	300/100	150/100
Yield Irrigated	Bu	33	35	29	35	36
Non Irrigated	Ac	300/20	300/70	200/0		
Yield Non Irrig.	Bu	15	25			
Total Acres	Ac	1,600/920	1,200/520	330/100	300/100	150/100
Corn						
Irrigated	Ac	2,200/800	2,700/640	2,400/700	2,750/800	2,500/1,020
Yield Irrigated	Bu	71	54	65	70	85
Non Irrigated	Ac	400/700	150/150	100/50	150/150	100/50
Yield Non Irrig.	Bu	14	11	9	23	25
Total Acres	Ac	2,600/1,500	2,850/790	2,500/790	2,900/950	2,600/1,070
Sorghum						
Irrigated	Ac	220/140	200/200	30/20	150/150	50/0
Yield Irrigated	Bu	42	36	45	46	
Non Irrigated	Ac	1/0				
Yield Non Irrig.	Bu					
Total Acres	Ac	220/140	200/200	30/20	150/150	50

Table 2-49--cont'd.

Wheat						
Irrigated	Ac	1,600/260	1,900/400	2,000/800	2,400/2,200	2,400/500
Yield Irrigated	Bu	39	37	42	47	35
Non Irrigated	Ac	400/270	400/200	300/0	300/	600/300
Yield Non Irrig.	Bu	19	16	17	9	10
Total Acres	Ac	2,000/530	2,300/600	2,300/800	2,700/2,200	3,000/800
All Hay						
Acres	Ac	15,100	14,300	14,420	14,000	15,000
Yield	Ton	3.7	3.5	3.8	3.5	3.89

1/ Acres planted/acres harvested.

2/ No entry means nothing was planted.

Source: New Mexico Agricultural Statistics, the New Mexico Crop and Livestock Reporting Service, USDA.

TABLE 2-50

VALENCIA COUNTY, NEW MEXICO
CROP DATA, PRODUCTION AND VALUE

(COUNTYWIDE DATA)

Item	Unit	1974	1975	1976	1977	1978
Barley						
Production	Bu	30,000	17,500	2,900	3,500	3,600
Value	Dollars	69,000	38,500	6,300	5,800	7,200
Corn						
Production	Bu	44,600	33,950	32,850	59,450	87,950
Value	Dollar	136,900	88,900	73,600	118,900	235,706
Sorghum						
Production	Bu	5,880	7,200	900	9,150	
Value	Dollars	18,200	17,700	1,800	17,200	
Wheat						
Production	Bu	14,440	18,000	34,400	116,300	20,500
Value	Dollars	57,800	63,400	100,000	244,200	62,320
Hay						
Production	Tons	56,030	50,150	54,110	49,000	58,300
Value	Dollar	3,277,800	2,708,100	3,436,000	2,817,500	3,498,000

Source: New Mexico Agricultural Statistics, the New Mexico Crop and Livestock Reporting Service, USDA.

LIVESTOCK PRODUCTION 1/

Tables 2-51 through 2-56 show livestock data for whole counties having land within the Little Colorado River Basin, 1974-78. Cattle are the most important type of livestock within the area, both in terms of number of animal units and value per head (Table 2-56). Over the 1974-78 period, the number of cattle increased in all counties except Valencia County, where herd size fell from 47,000 to 35,000. The largest rates of increase occurred in Coconino County (55%) and McKinley County (42%), followed by Navajo County (38%), Catron County (28%) and Apache County (10%). The dollar value of herds fell off sharply in 1975, recovering slowly through the late seventies. Data available for Navajo County suggests a very marked increase in value per head of cattle in 1979.

Other livestock raised within the Basin include sheep and hogs. The value per head of sheep has increased relatively gradually over the 1974-78 period throughout the Basin. More recent data for Navajo County show a substantial increase in value per head in 1979. The value of hogs within the Basin has also tended to increase over the 1974-78 period. Data for sheep and hogs has been included for those counties where the raising of sheep and hogs represents an important economic activity (Table 2-57).

The value of livestock sales in current year dollars and in 1977 dollars is shown in Table 2-40 for Arizona counties. Apache County livestock sales appear to increase from $8,806,000 in 1972 to $22,284,000 in 1978 or by a factor of 2.5 When all years are put in terms of 1977 dollars, the real increase is only from $11,386,000 to $18,072,000 or a factor of 1.6.

LIVESTOCK PROJECTIONS

The projections of livestock shown in Table 2-58 were based on discussions with livestock specialists in Arizona and New Mexico.

A major consideration in projecting only a slight increase in cattle numbers (10 percent increase by 2020) was the overgrazed condition of much of the range. Rangeland managers are expected to limit cattle numbers to improve the vegetativ condition of the range. They will be pressured to do this both for environmenta considerations and for economic reasons. Range in poor condition produces less forage per acre than range in good condition and leaves the soil more exposed to wind and water erosion.

There were about 80,000 cows in the Basin in 1975. By 2020 this number is projected to increase by 10 percent to 88,000 (Table 2-58). The increase by 1990 is projected to be 3.3 percent and by 2020 about 5.8 percent.

The number of sheep shorn in all of Arizona declined from 430,000 in 1976 to 354,000 in 1978. 2/ Wool production for the same period was down from 2,875,000 pounds in 1976 to 2,593,000 in 1978. Specialists believed that the trend would continue downward but were reluctant to say how much. For the Little Colorado

1/Values shown in Tables 2-51 through 2-56 are not corrected for inflation.

2/"Sheep, Lambs and Goats, Final Estimates for 1976-79," USDA, ESS, Crop Reporting Board, Statistical 653, Jan. 1981.

TABLE 2-51

APACHE COUNTY, ARIZONA LIVESTOCK DATA

(COUNTYWIDE DATA)

Item	Unit	1974	1975	1976	1977	1978
All Cattle	No.[1/]	48,000	52,000	41,200	44,000	52,800
Milk Cows	"	-	-	-	-	-
Beef Cows	"	34,000	36,000	25,000	21,800	NA
Other Cattle	"	14,000	16,000	21,000	19,200	NA
All Hogs	"	-	-	-	-	-
All Sheep	"	121,800	132,000	106,000	104,000	114,000
All Chickens	"	NA[2/]	NA	NA	NA	NA
Range Cattle	No.	NA	NA	41,200	43,800	52,700
Cattle & Calf						
Out-Shipments	"	17,402	15,846	19,323	15,938	18,453
In-Shipments	"	3,076	2,612	2,545	4,087	2,985
Value per head of all Cattle	Dollars[3/]	325	165	195	215	240
Value all Cattle	"	15,600,000	8,580,000	8,034,000	9,460,000	12,672,000
Value per head of all Sheep	Dollars	28.00	30.50	33.00	37.50	43.00
Value all Sheep	"	3,410,400	4,026,000	3,498,000	3,900,000	4,902,000

1/ Number on farms as of January 1 of each year.

2/ Not available.

3/ All dollars are in current year terms, i.e., not corrected for inflation.

Source: Arizona Agricultural Statistics, the Arizona Crop and Livestock Reporting Service, USDA.

TABLE 2-52

COCONINO COUNTY, ARIZONA LIVESTOCK DATA
(COUNTYWIDE DATA)

Item	Unit	1974	1975	1976	1977	1978
All Cattle	No.	46,000	50,000	75,600	69,100	71,300
Milk Cows	"	-	-	-	-	-
Beef Cows[1/]	"	30,000	33,000	NA	NA	NA
Other Cattle	"	16,000	17,000	NA	NA	NA
All Hogs						
All Sheep	"	NA	NA	83,500	101,000	95,000
All Chickens	"	NA	NA	NA	NA	NA
Range Cattle	"	NA	NA	75,600	68,900	71,100
Cattle & Calf						
Out-Shipments	"	13,538	14,630	13,934	14,709	18,234
In-Shipments	"	1,470	262	798	1,756	985
Value per head of all Cattle	Dollars	325	165	195	215	240
Value all Cattle	"	14,950,000	8,250,000	14,742,000	14,856,500	17,112,000

1/ All cows that have calved.

NA = Number not available

Source: Arizona Agricultural Statistics, the Arizona Crop and Livestock Reporting Service, USDA.

TABLE 2-53

NAVAJO COUNTY, ARIZONA LIVESTOCK DATA

(COUNTYWIDE DATA)

Item	Unit	1974	1975	1976	1977	1978
All Cattle	No.	32,000	35,000	38,300	32,100	36,300
Milk Cows						
Beef Cows[1/]	"	25,000	27,000	NA	NA	NA
Other Cattle	"					
All Hogs	"	25,600	26,000	27,000	32,000	44,000
All Sheep	"	91,300	84,000	75,500	66,000	58,000
All Chickens	"	NA	NA	NA	NA	NA
Range Cattle	"	NA	NA	37,800	31,300	34,900
Cattle & Calf						
Out-Shipments	"	9,655	13,493	12,287	12,351	21,280
In-Shipments	"	790	2,162	1,768	3,710	1,376
Value per head of all Cattle[2/]	Dollars	325	165	195	215	240
Value all Cattle	"	10,400,000	5,775,000	7,468,500	6,901,500	8,712,000
Value per head of all Hogs	Dollars	48.50	63.00	48.00	55.50	71.50
Value all Hogs	"	1,241,600	1,638,000	1,296,000	1,776,000	3,146,000
Value per head of all Sheep	Dollars	28.00	30.50	33.00	37.50	43.00
Value all Sheep	"	2,556,400	2,562,000	2,491,500	2,475,000	2,494,000

1/ Cows that have calved.

2/ State average price.

NA = Not available.

Source: Arizona Agricultural Statistics, the Arizona Crop and Livestock Reporting Service, USDA.

TABLE 2-54

CATRON COUNTY, NEW MEXICO LIVESTOCK ON FARMS

(COUNTYWIDE DATA)

Item	Unit	1974	1975	1976	1977	1978
All Cattle	No.	43,000	53,000	53,000	53,000	55,000
Milk Cows	"	100	100	100	100	100
Beef Cows	"	23,900	24,900	23,900	23,900	22,900
Other Cattle	"	19,000	25,000	24,000	29,000	32,000
All Hogs	"	300	300	300	400	200
All Sheep	"	-	-	-	-	-
All Chickens	"	1,300	1,300	900	900	1,000
Value per head of all Cattle	Dollars	295	135	165	175	195
Value all Cattle	"	12,685,000	7,155,000	8,745,000	9,275,000	10,725,000

Source: New Mexico Agricultural Statistics, the New Mexico Crop and Livestock Reporting Service, USDA.

TABLE 2-55

MCKINLEY COUNTY, NEW MEXICO LIVESTOCK ON FARMS

(COUNTYWIDE DATA)

Item	Unit	1974	1975	1976	1977	1978
All cattle	No.	19,000	19,000	20,000	20,000	27,000
Milk cows	"	100	100	100	100	100
Beef cows	"	13,900	13,900	13,900	13,900	14,900
Other cattle	"	5,000	5,000	6,000	6,000	12,000
All Hogs	"	300	300	300	400	700
All Sheep	"	96,700	81,000	83,800	79,400	88,000
All Chickens	"	1,200	1,000	2,000	2,000	2,000
Value per head of all Cattle	Dollars	295	135	175	175	
Value all Cattle	"	5,605,000	2,565,000	3,500,000	3,500,000	5,265,000
Value per head of all Sheep	Dollars	30.5	28.3	36.0	40.5	47.5
Value all Sheep	"	2,949,400	2,294,800	3,013,200	3,219,800	4,180,000

Source: New Mexico Agricultural Statistics, the New Mexico Crop and Livestock Reporting Service, USDA.

TABLE 2-56

VALENCIA COUNTY, NEW MEXICO LIVESTOCK ON FARMS

(COUNTYWIDE DATA)

Item	Unit	1974	1975	1976	1977	1978
All Cattle	No.	47,000	45,000	40,000	40,000	35,000
Milk Cows	"	3,600	3,600	3,500	3,400	3,700
Beef Cows	"	23,400	22,400	19,500	19,600	18,300
Other Cattle	"	20,000	19,000	17,000	17,000	13,000
All Hogs	"	1,700	1,700	1,500	2,100	2,100
All Sheep	"	27,200	35,200	37,400	35,500	32,000
All Chickens	"	4,800	5,000	4,000	4,000	4,000
Value per head of all Cattle	Dollars	295	135	165	175	195
Value all Cattle	"	13,865,000	6,075,000	6,600,000	7,000,000	6,825,000
Value per head of all Sheep	Dollars	30.5	25.5	35.00	40.5	47.5
Value of all Sheep	"	829,600	897,600	1,309,000	1,437,800	1,520,000

Source: New Mexico Agricultural Statistics, the New Mexico Crop and Livestock Reporting Service, USDA.

TABLE 2-57

VALUE OF CATTLE AND SHEEP PRODUCTION

(COUNTYWIDE DATA)

COUNTY	ALL CATTLE		ALL SHEEP		ALL HOGS	
	1974	1978	1974	1978	1974	1978
	1,000 dollars					
Arizona Counties						
Apache	15,600	12,672	3,410	4,902	-	-
Coconino	14,950	17,112	-	-	-	-
Navajo	10,400	8,712	2,556	2,494	1,242	3,146
Arizona Total	40,950	38,496	5,966	7,396	1,242	3,146
New Mexico Counties						
Catron	12,685	10,725	-	-	-	-
McKinley	5,605	5,265	2,949	4,180	-	-
Valencia	13,865	6,825	829	1,520	-	-
New Mexico Total	32,155	22,815	3,778	5,700	-	-

Source: Arizona and New Mexico Agricultural Statistics, Crop and Livestock Reporting Service.

TABLE 2-58

LIVESTOCK NUMBERS AND ANIMAL UNITS FOR COUNTY AREAS WITHIN THE LITTLE COLORADO RIVER BASIN 1975, 1990, 2000 and 2020[1/]

(BASIN DATA)

	1975		1990		2000		2020	
	No.	A.U.'s	No.	A.U.'s	No.	A.U.'s	No.	A.U.'s
	1000's							
All Cows[2/]								
Apache	26.6	39.0	27.5	40.3	28.1	41.2	29.2	43.0
Navajo	25.9	38.1	26.7	39.4	27.3	40.2	28.5	41.9
Coconino	2.9	4.3	3.0	4.4	3.1	4.5	3.2	4.7
AZ Total	55.4	81.4	57.2	84.1	58.5	85.9	60.9	89.6
McKinley	6.4	9.4	6.6	9.7	6.8	10.0	7.1	10.4
Valencia	11.4	16.8	11.8	17.3	12.1	17.7	12.6	18.5
Catron	6.7	9.8	6.9	10.2	7.1	10.4	7.4	10.9
NM Total	24.5	36.0	25.3	37.2	26.0	38.1	27.1	39.8
Basin Total	79.9	117.4	82.5	121.3	84.5	124.0	88.0	129.4
Index (Pct. re. 1975)	100.0		103.3		105.8		110.0	
Sheep and Lambs								
Apache	43.2	8.6	38.9	7.8	36.0	7.2	30.3	6.1
Navajo	70.2	14.1	63.2	12.7	58.5	11.7	49.2	9.8
Coconino	41.2	8.2	37.1	7.4	34.3	6.9	28.9	5.8
AZ Total	154.6	30.9	139.2	27.9	128.8	25.8	108.4	21.7
McKinley	42.8	8.6	38.5	7.7	35.7	7.1	30.0	6.0
Valencia	0.0	0	0	0	0	0	0	0
Catron	2.4	.5	2.2	.4	2.0	.4	1.7	.3
NM Total	45.2	9.1	40.7	8.1	37.7	7.5	31.7	6.3
Basin Total	199.8	40.0	179.9	36.0	166.5	33.3	140.1	28.0
Index (Pct. re. 1975)	100.0		90.0		83.3		70.0	

[1/] All data are for the county area inside the Little Colorado River Basin. Portions inside the Basins are based on discussions with persons knowledgeable about each county and are estimates only--not a precise count.

[2/] The higher number of animal units of feed reflects the sale of cattle for slaughter during the year. Inventory numbers are for the lowest point of the year.

Table 2-58--cont'd.

Item	1975		1990		2000		2020	
	No.	A.U.'s	No.	A.U.'s	No.	A.U.'s	No.	A.U.'s
	1000's							
Horses and Colts								
Apache	7.1	7.1	9.2	9.2	10.7	10.7	12.1	12.1
Navajo	10.4	10.4	13.5	13.5	15.6	15.6	17.7	17.7
Coconino	3.3	3.3	4.3	4.3	5.0	5.0	5.6	5.6
AZ Total	20.8	20.8	27.0	27.0	31.3	31.3	35.4	35.4
McKinley	.4	.4	.5	.5	.6	.6	.7	.7
Valencia	.3	.3	.4	.4	.4	.4	.5	.5
Catron	.2	.2	.3	.3	.3	.3	.3	.3
NM Total	.9	.9	1.2	1.2	1.3	1.3	1.5	1.5
Basin Total	21.7	21.7	28.2	28.2	32.6	32.6	36.9	36.9
Index (Pct. re: 1975)	100.0		130.0		150.0		170.0	
Hogs and Pigs								
Apache	-	-	-	-	-	-	-	-
Navajo	26.2		34.1		39.2		45.1	
Coconino	-	-	-	-	-	-	-	-
AZ Total	26.2		34.1		39.2		45.1	
McKinley	.1		.2		.3		.4	
Valencia	-	-	-	-	-	-	-	-
Catron	-	-	-	-	-	-	-	-
NM Total	.1		.2		.3		.4	
Basin Total	26.3		34.3		39.5		45.5	
Index (Pct. re: 1975)	100.0		130.4		150.2		173.0	

Basin the number of sheep in the Basin comprised about 40,000 animal units in 1975. This number is projected to decline to about 28,000 animal units by 2020.

It was estimated that there were about 21,700 head of horses and colts in the Basin in 1975. People knowledgeable about the horse industry say their number is growing parallel to the growth of the human population. Their number is projected to increase by 30 percent from 1975 to 1990, by 50 percent from 1975 to 2000 and by 70 percent from 1975 to 2020 (Table 2-58).

The only significant hog population in the Basin is in Navajo County and is controlled by a few families. This is a unique situation and any projection for 1990 and beyond is purely guesswork. The operations are successful even though all feed is imported from grain producing areas as far away as Texas. Since there is potential for these operations to be expanded by present owners or their heirs, a conservative increase of 30 percent by 1990, 50 percent by 2000 and 73 percent by 2020 is projected.

The projected animal units for cows, sheep and horses is estimated as follows:

Year	Equivalent Animal Units
1975	179,100
1990	185,500
2000	189,900
2020	194,300

Animal units were not shown for hogs since they do not normally utilize range forage. Hog feed required will be imported or produced on irrigated cropland.

SUMMARY

(Socio-Economic Base)

The central question addressed by the Little Colorado River Basin Study is "how should the Basin's natural resources be managed over the long run to optimize the well-being of present and future residents of the Basin?" This section of Appendix I describes the social and economic aspects of the various categories of resource use and problems.

The Basin's population is expected to grow from the 162,200 in 1975 to around 426,000 in 2020 (Table 2-8). This growth can be partially attributed to a general trend of migration from northern urban areas to rural areas of the sun-belt states. In McKinley and Valencia Counties of New Mexico the higher national demand for coal and uranium will also contribute to population increase. In Coconino County, Arizona there will be significant growth in tourism, education (Northern Arizona University) lumbering and manufacturing. Recently there has been an increase in second home ownership in some of the scenic areas of the Basin. This trend could be seriously dampened if gasoline costs continue to increase.

The expansion or new construction of electric generating stations are currently stimulating the economies of certain areas of Navajo and Apache counties. The Arizona Public Service Company is adding a fifth unit at its site 2 miles east of Joseph City, Arizona. The Salt River Project is constructing a new facility north of St. Johns, Arizona and the Tucson Electric Power Company is constructing the first of three units to be built at a site 10 miles north of Springerville, Arizona.

These are all coal fired plants, thus they will be using some coal produced in the Basin and will have a fairly strong multiplier linkage to the rest of the economy through the use of local coal.

Coconino, Navajo and Apache Counties account for $52,000,000 of Arizona's $97,000,000 of taxable income from timber sales. 1/ This industry is very important in the Basin's economy. However, its expansion depends largely on improvements in management that bring about increased production per acre. Much of the timber harvest in the Basin is controlled by the U.S. Forest Service according to long term conservation and management goals. There may be opportunities for expansion for timber manufacturing in the Basin. Such expansion utilizing local raw materials would have a higher economic multiplier than expansion in an industry which must purchase raw materials from outside the Basin. For the same reason growth in the construction sector which utilizes locally produced timber products would have a good multiplier effect on the rest of the economy. An example would be more home building due to increases in either the permanent or seasonal population.

If there is rapid population buildup in any particular area there will be a potential for more pollution. Visual quality, air quality and water quality can easily be reduced if rapid population buildup is not planned for and controlled by zoning and building codes which are effectively administered.

Councils of Government's staff people are available in both Arizona and New Mexico to assist city and county officials to foresee and plan for orderly growth. They also help communities locate sources of funds to help meet local needs. The Resource, Conservation and Development Projects coordinated by the Soil Conservation Service also can assist in planning and locating financial support for community resource development or conservation projects.

The value of the main crops produced in the six counties in 1978, according to rank by value of production, were hay ($3.9 million), corn ($639,000), wheat ($320,000) and sorghum ($242,000). In Arizona Counties there are about 29,870 acres of irrigated cropland in New Mexico about 4,950 acres of irrigated cropland inside the Basin. Most of the production shown for New Mexico Counties was outside the Basin boundaries.

Range cattle production is the main livestock enterprise in the Little Colorado River Basin. Value of production for the entire six counties in both states dropped, however, from about $82 million in 1974 to about $63 million in 1978. This was a healthy trend as far as range conditions are concerned. Much range is in an overgrazed condition and should have cattle numbers decreased for several years to allow the grazing to come back to full production.

1/ Arizona Statistical Abstract, 1979.

Sheep production is also important in both states. The value of sheep produced in the three Arizona Counties in 1974 was about $6 million; in New Mexico about $3.7 million. In 1978 these figures had increased to $7.4 million and $5.7 million respectively.

There was a significant hog producing industry only in Navajo County, Arizona. Its production increased from $1.2 million in 1974 to $3.1 million in 1978.

The primary socio-economic problem facing communities in the Little Colorado River Basin is to plan for orderly development over the next 50 years. There is a trend for industry and population to move into the sunbelt states. Northern Arizona and New Mexico hold high appeal to many outsiders not only from outside the state but also from cities within Arizona and New Mexico.

Community and county officials and other leaders must acquire the needed expertise to assist them in planning for long term, orderly growth in a manner that will preserve the quality of life and environmental qualities which they wish to pass on to their children.

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